American Foundryman

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CONTENTS

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This Month's Cover

A battery of pin lift jolt squeeze molding machines with overhead sand supply installed in a mechanized malleable jobbing foundry.

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TRAINED LEADERSHIP— THE NEED AND THE OPPORTUNITY

MUCH HAS BEEN accomplished in mechanizing the casting industry to improve working conditions, increase production and improve the product, and at the same time, this new development has presented a need for more and better management. Better planning in the use of machinery and material, elimination of idle time, and keeping a smooth flow of operation becomes more important each year. The recent organization of the Foundry Educational Foundation with its slogan "The Foundry Goes to College" will strengthen the training program and perpetuate a supply of technical men for control on the quality of the product.

Management institutes, with their round-table discussions on current problems such as labor relations, human engineering and public relations, are offering opportunities for exchange of ideas for executives and offering a source of re-education for those new in the industry.

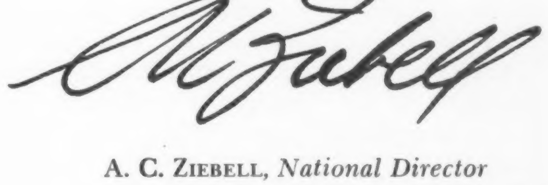
Engineered management with its job evaluation, setting of standards, preparation of forecasts, screening and testing—all have their place in the promotion of efficiency and have emphasized the need for strong leadership to make them function properly.

With all these fine objectives there still remains a program to strengthen leadership training along management lines. The numerous A.F.A. chapters are doing a good job in teaching foundrymen to rise to their feet and speak at round-table discussions. More can be accomplished in assigning subjects to foremen, department heads and other key men that will encourage them to talk before an audience on positive subjects. During the past years of confusion and control, many have devoted so much time to negative problems that a reversal of effort would serve as a mental tonic.

The Annual Chapter Chairman Conference offers an opportunity for Chapter Chairmen and Vice-Chairmen to present talks before a group meeting, which is a step toward leadership training. These annual chapter conferences, and the monthly sectional meetings, provide additional sources for selecting speakers to talk on opposite sides of foundry problems, which will have a double benefit in making an interesting meeting and developing leadership.

Engineered management offers many subjects vital to the production of more and better castings at lower cost. Controlled training in public speaking and in collecting information will develop better types of leaders to make engineered management function at its best. It will add salesmanship, executive ability necessary to smooth the flow of production, and, above all, it will stimulate positive management, resulting in increased efficiency for the industry.

In the preparation of programs for the chapters, set aside a meeting or two for *leadership training* and give the practical man an opportunity to develop the "man" in "management."



A. C. ZIEBELL, *National Director*
AMERICAN FOUNDRYMEN'S ASSOCIATION

One of the newly elected National Directors is A. C. Ziebell, president and treasurer, Universal Foundry Co., Oshkosh, Wis. Has been active for a number of years in foreman training work and has also served as president, A.F.A. Wisconsin Chapter.

BOARD OF DIRECTORS ANNUAL MEETINGS

THE A.F.A. NATIONAL Officers and Directors held their two-day annual meetings, July 29-30, at the Palmer House, Chicago, to review accomplishments of the past year and formulate plans for the months ahead.

S. V. Wood, Minneapolis Electric Steel Castings Co., Minneapolis, Minn., presided the first day as the retiring A.F.A. President. The gavel then was turned over the second day to President-elect Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va. This action culminated an active year during which the Board faced and acted upon many problems of unusual nature, taking steps that may be expected to broaden and improve the work of the Association.

During the 12 months ended June 30, 1947 a total net increase of 1144 members was shown by the Association. Approximately 91 per cent of the membership is affiliated with the 37 A.F.A. chapters located throughout the United States, Canada and Mexico. This increase not only shows a more pronounced demand for A.F.A. service but also imposes upon the Association definite obligations for adding to existing services.

Five Chapters Added

Five new chapters of A.F.A. were organized successfully during the year 1946-47, as announced at the board meeting. Fine and initial support has been given the British Columbia, Central Michigan, Washington, Timberline, and Tri-State chapters. Several other chapter possibilities are being considered in areas where enough interest has been shown.

The Technical Director reviewed the past fiscal year and emphasized the accomplishments made in reorganization of the technical committees, the establishment of a definite plan for A.F.A. sponsored research and increasing the tempo of educational activities.

At this time it was pointed out that it was necessary to have a year-to-year continuity from the Board in its dealings with the Technical Correlations Committee. The Board approved the resolution that Board representation on this committee henceforth consist of the immediate past President as Chairman, with the incumbent President as Vice-Chairman.

The Technical Director called attention to the continuation of the sand research program at Cornell University, Ithaca, N.Y., and the heat transfer project at Columbia University, New York City. He also stated that, following board approval a year ago of a definite plan for A.F.A. sponsored research, the A.F.A. Aluminum and Magnesium Division had submitted a research program which had been approved by the A.F.A. Board of Directors, as had the research projects for the Brass and Bronze Division and Malleable Division. (Editor's note: For further details concerning projects see p. 36.)

It was brought out that the A.F.A. Educational Division program has been carried on actively during the past year with the preparation of articles and booklets, close cooperation with Chapter Educational Committees, formation of a Youth Encouragement Committee and the preparation of numerous articles on educational subjects. The Board passed a resolution approving the recommendation of the Technical Correlations Committee for preparation of adequate and appropriate textbooks at several educational levels, subject to later approval by the Board of specific projects as submitted by the A.F.A. Educational Division.

On the recommendation of A.F.A. President Max Kuniansky, the Board approved the following Executive Committee for 1947-48:

President Max Kuniansky.

Vice-President W. B. Wallis, Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa.

Director Jas. H. Smith, Central Foundry Div., General Motors Corp., Saginaw, Mich.

Director and immediate past President S. V. Wood, Minneapolis Electric Steel Castings Co., Minneapolis.

Director S. C. Wasson, National Malleable & Steel Castings Co., Chicago.

Director John M. Robb, Jr., Hickman, Williams & Co., Philadelphia.

Retirement Plans

For the past six months members of the Board have been considering recommendations and details for setting up a permanent staff retirement plan. At the July 30 meeting of the new Board definite proposals were submitted and referred to the directorate as a whole for individual comments and suggestions. It is expected that the Board's discussion on a feasible plan will be materially advanced during the coming year.

The retiring members of the Board expressed their appreciation of the opportunity to have served under President Wood and the following resolution was adopted:

> That the Board of Directors go officially on record to thank President Wood for his con-

scientious and successful term of office, and that they extend to Mrs. Wood the Board's gratitude for the great amount of time spent by the President away from his family during the previous year.

The Finance Committee presented for consideration a budget of estimated income and expense for the fiscal year July 1, 1947 to June 30, 1948 and it was accepted by the Board.

President Kuniansky appointed the personnel for the following Standing and Special Committees: Finance Committee, National Membership Committee, Chapter Contacts Committee, Technical Correlations Committee, International Relations Committee and representation on National Castings Council.

Attending the July 29-30 Board meetings were 21 National Officers and Directors, leading figures of the foundry industry elected by the membership to chart the course for A.F.A. progress. In addition to retiring President S. V. Wood, all newly-elected Officers and Directors were present—with the exception of Vice-President elect W. B. Wallis who is on an extensive European trip—President elect Max Kuniansky and Directors elect E. H. Delahunt, Warden King Ltd., Montreal, Que.; W. J. MacNeill, G. H. R. Foundry Div., Dayton Malleable Iron Co., Dayton, Ohio; R. H. McCarroll, Ford Motor Co., Dearborn, Mich.; John M. Robb, Jr., Hickman, Williams & Co., Philadelphia, and A. C. Ziebell, Universal Foundry Co., Oshkosh, Wis.

Other Directors responding to roll call were: G. K. Dreher, Foundry Educational Foundation, Cleveland; E. W. Horlebein, Gibson & Kirk Co., Baltimore, Md.; H. H. Judson, Standard Foundry Co., Worcester, Mass.; Jas. H. Smith, Central Foundry Div., General Motors Corp., Saginaw, Mich.; F. M. Wittlinger, Texas Electric Steel Casting Co., Houston, Texas; H. A. Deane, American Brake Shoe Co., New York; B. L. Simpson, National Engineering Co., Chicago, and S. C. Wasson, National Malleable & Steel Castings Co., Chicago.

A special dinner was held the evening of July 29 in honor of the service rendered A.F.A. by the following retiring directors:

Frank J. Dost, Sterling Foundry Co., Wellington, Ohio.

S. D. Russell, Phoenix Iron Works, Oakland, Calif.

R. T. Rycroft, Kencroft Malleable Co., Inc., Buffalo, N.Y.

Joseph Sully, Sully Foundry Div., Neptune Meters, Ltd., Toronto, Ont., Canada.

L. C. Wilson, Reading, Pa.

Fred J. Walls, International Nickel Co., Detroit.

Action taken by the Board with reference to staff appointments, concerned the re-election of W. W. Maloney as Secretary-Treasurer.

Max Kuniansky

W. B. Wallis

S. V. Wood

Members of the A.F.A. Executive Committee who will serve during the 1947-48 fiscal year.

Jas. H. Smith

John M. Robb, Jr.

S. C. Wasson

CAST BOLTS FOR PIPE JOINTS

An interesting foundry paper presented before the Semi-Annual Meeting of ASME in Chicago, June 16-19, 1947.

C. K. Donoho
Chief Metallurgist
American Cast Iron Pipe Co.
Birmingham, Ala.

BOLTS USED for assembling mechanical joints for pipe constitute a vital part of the pipe line construction. The bolts must maintain adequate compression of the gasket against all challenges of internal pressure, external load, joint movement, and corrosion. The primary qualifications for such a bolt are: (1) high yield strength, (2) toughness and ductility sufficient to withstand any ordinarily encountered shock or bending stresses, and (3) corrosion resistance equal to, or better than, the pipe with which it is used.

For cast iron pipe joints several types of bolts have been used. Mild steel bolts have the requisite ultimate strength and toughness but may be low in yield strength. With a strong arm on the bolt wrench mild steel bolts have been stressed past the yield point so that they continue to stretch after the joint is made, eventually permitting the joint to leak.

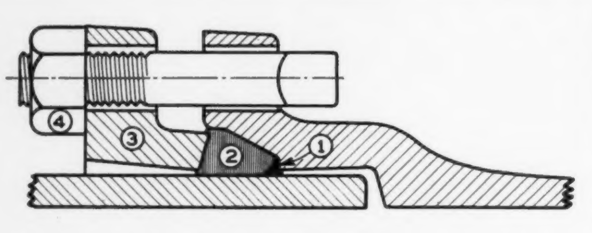


Fig. 1—A typical mechanical joint for cast iron pipe. 1—Lead ring. 2—Endless ring gasket. 3—Cast iron gland. 4—High strength cast iron bolts.

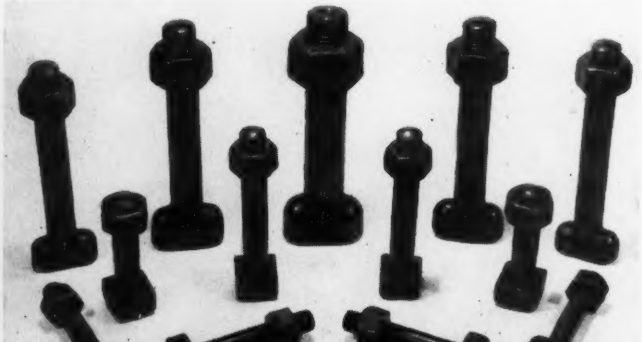


Fig. 2—A few of the standard types of cast bolts.

In this case high ductility is actually detrimental, since it is better for the bolt to break when stressed past the yield point, in which case it is replaced immediately. The corrosion resistance of steel bolts is an important consideration. Since the bolt is an exposed vital element, corrosive conditions often may cause failure of the bolt before the pipe itself has been affected appreciably. Galvanizing or cadmium plating of steel bolts affords only temporary protection in aqueous or underground corrosive environments.

Regular malleable iron bolts also are low in yield strength and are approximately as corrodible as steel. High strength pearlitic malleable bolts alloyed for corrosion resistance have given satisfactory service. Bronze and stainless steel bolts may be used for the most severe conditions but are relatively expensive. This paper describes one method of production of cast bolts with the desired qualifications for pipe line service.

Bolts Used for Mechanical Joints

Developed in the foundry of the company with which the author is associated, these cast bolts have been in continuous production since 1937 (U.S. Patent No. 2,220,792). The principal use is for mechanical joints in cast iron pipe lines for conveying liquids and gases (Fig. 1). Sizes cast range from $\frac{5}{8}$ to $1\frac{1}{2}$ in. in diameter and from 3 to 7 in. in length (Fig. 2). The metal composition, method of casting, and heat treatment of these bolts constitute a unique and interesting metallurgical process.

The metal is melted in a cupola and cast into individual metal molds (or dies) to form the bolt blank. Quick freezing by reason of the chilling action of the metal mold causes the iron to cast "all white," i.e., essentially with no free carbon. Subsequent heat treatment converts the hard, brittle, white iron to a malleable structure which is strong and tough, yet easily machineable. The metal mold process allows the use of an iron composition radically different from that of ordinary cupola malleable, and the compositional changes permit complete malleableization with an unusually short anneal.

Melting is presently carried out in a 24 in. diameter cupola producing about 2 tons of molten iron per hour.

The metal charge is composed essentially of steel, return scrap and high silicon pig iron. Iron to coke ratio is about 5 to 1. The molten metal flows continuously from the cupola breast into a mixing and desulphurizing ladle of capacity sufficient to hold three or four complete charges. From the mixer, iron is taken in 25-lb hand ladles for casting. The desired average analysis in percentages is as follows: T.C., 2.50; Si, 3.00; Mn, 0.85; P, 0.12 (max.); S, 0.15 (max.); Cu. 1.25.

Melting of iron as low as 2.50 per cent carbon in the cupola is facilitated by the high silicon and copper contents, which reduce the carbon solubility. The temperature of metal from the cupola is 2750 to 2800 F, and casting temperature averages about 2450 F.

Bolt blanks are cast one at a time in split metal molds mounted on a turntable carrying 60 molds. The turntable makes one complete revolution every 2 to 3 min. At the pouring side of the turntable the two-part molds are held in the closed position by springs. At the opposite side pusher arms, acting on a cam at the center of the wheel separate the split molds to allow removal of the solidified castings, as shown in Fig. 3. The molds are open at the top end and are poured by hand, head up, the head height being controlled by the pourer. Bolts are cast and stripped on one turntable at the rate of about 25 per min (Fig. 4).

Fig. 3—View of bolt machine showing molds opening at left to permit removal of the hot castings.

Mold Construction

The molds are machined from blocks of soft gray cast iron. Blocks are accurately faced, and the mold cavity which forms the bolt blank is milled. In operation, the mold cavities are coated with acetylene soot from an automatically controlled torch mounted above the wheel after the stripping station and preceding the casting (Fig. 5). Soot coating protects the mold and produces a smooth-surfaced casting. A mold will produce about 5000 bolts before it must be re-worked.

Fig. 4—Turntable pouring of bolts from a hand ladle. Bolts are cast and stripped at rate of 25 per min.

The as-cast bolt blanks, of hard, brittle, white iron, are placed on alloy trays and annealed in a continuous pusher-type annealing furnace. The time temperature cycle each bolt undergoes is approximately as follows: heat to 1750 F; hold 1½ hr; air cool; reheat to 1550 F; cool to 1250 F in 1½ hr and air cool.

This treatment decomposes substantially all of the combined carbon to produce a true malleable structure (Fig. 6). The air cool from 1250 F is used in order to retain most of the copper in solution—an important factor for best ductility and corrosion resistance. The annealed bolt blanks are then rattled, gaged, and threaded in production bolt-threading machines.

Fig. 5—General view of bolt casting unit. Mixing ladle at right center. Automatically controlled acetylene torch for soot coating molds is shown at left.

Nuts are cast in sand of soft gray iron, but with 2 per cent of copper for corrosion resistance. These are annealed at 1600 F to facilitate tapping. The nut iron has a tensile strength of only about 35,000 psi compared with about 65,000 psi for the malleableized bolt. Many tests have proved, however, that a high unit strength is not necessary for the nuts. Tightening the bolt and nut together in a joint to failure will almost invariably cause the bolt to break in tension before the nut fails.

Hardness and strength values of the bolt metal so produced are considerably higher than those of ordinary malleable iron, because of effect of 3 per cent of silicon and 1¼ per cent of copper in solid solution.

Sample bolts for test are selected three times in each

Table 1—Chemical and Physical Tests of Standard Cast Iron Bolts

Tests		Composition, per cent							Properties		
Date	Time	Si	S	Mn	C	P	Cr	Cu	Bend, $\frac{1}{16}$ in. deflection	Tensile Strength, 1000 psi	BHN
10-14-46	8	3.04	0.082	0.77	2.47	0.10	0.042	0.96	4.2	63.3	187
	11	3.06	0.090	0.83	2.40	0.11	—	—	4.9	61.3	192
	1	3.11	0.093	0.85	2.37	0.10	0.042	1.17	5.6	63.0	187
10-15-46	8	2.86	0.132	0.72	2.48	0.10	0.042	1.31	5.6	67.5	179
	11	3.08	0.093	0.87	2.49	0.10	0.043	1.40	4.2	64.1	179
	1	3.12	0.080	0.90	2.54	0.10	0.040	1.14	4.9	64.6	183
10-16-46	8	3.10	0.129	0.92	2.63	0.09	0.045	1.25	4.0	61.0	187
	11	3.00	0.124	0.85	2.46	0.11	0.046	1.41	4.8	60.7	179
	1	3.10	0.104	0.83	2.55	0.13	0.044	1.18	4.2	58.9	179
10-17-46	8	2.74	0.101	0.75	2.51	0.10	0.041	1.24	4.2	69.0	170
	11	3.10	0.114	0.91	2.49	0.09	0.042	1.06	4.8	64.6	179
	1	3.10	0.071	0.89	2.71	0.08	0.046	1.18	5.6	68.2	170
10-18-46	8	2.89	0.090	0.85	2.56	0.09	0.044	1.50	4.8	62.4	179
	11	2.75	0.081	0.80	2.57	0.12	0.047	1.59	3.8	63.6	187
	1	2.98	0.110	0.87	2.57	0.09	0.046	1.31	5.6	67.3	179
Averages		3.00	0.100	0.84	2.52	0.10	0.044	1.26	4.7	63.9	181

8-hr heat. A typical week's test report is shown in Table I. The tensile test is made by pulling a threaded bolt to failure and calculating the result by dividing the ultimate load by the area at the root of the threads.

The bend test results are expressed in sixteenths of an inch vertical deflection of a ¾ in. diameter bolt blank on a 6-in. span when loaded at the center through a 1 in. diameter pin. This is a simple and useful measure of the ductility of the metal and indicates the degree to which the bolt will adjust itself to unequal loading in a pipe joint. Tests of conventional 0.505 in. diameter machined tensile bars have been made on the bolt metal cast in a special metal test bar mold. A typical tensile load-elongation curve is shown in Fig. 7.

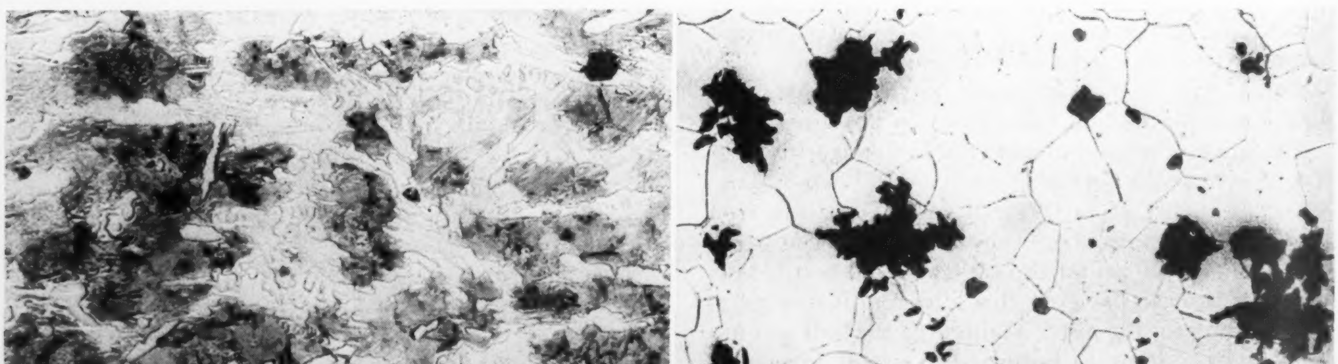
Fig. 6—Photomicrographs showing structure of standard bolt metal. Etched in Nital. X500. A—As-cast white iron—cementite (white) and pearlite (gray). B—Annealed—ferrite (white) and graphite (dark). Gray inclusions are manganese sulphide.

The test bar properties (Fig. 7) of 60,000 psi yield strength with 5.3 per cent elongation may be evaluated by comparison with ASTM A107-39 requirements for cupola malleable iron of 30,000 psi minimum yield point with 5 per cent minimum elongation. ASTM specification A-47-33 for regular malleable iron castings requires 32,500 psi yield point with 10 per cent elongation, while the requirements for the high strength grade are 35,000 psi yield point and 18 per cent elongation.

Bolts Proof Tested

In addition to the laboratory tests on sample bolts, the finished bolt-nut assemblies are proof tested to 50,000 psi in tension. Proof testing is not 100 per cent but is carried out in accordance with a sampling plan which tests about 20 to 30 per cent of all bolts to maintain an average out-going quality level of only 1 per cent below 50,000 psi strength.

The good machineability of malleable structure irons is well known, and it is apparent that this bolt mate-



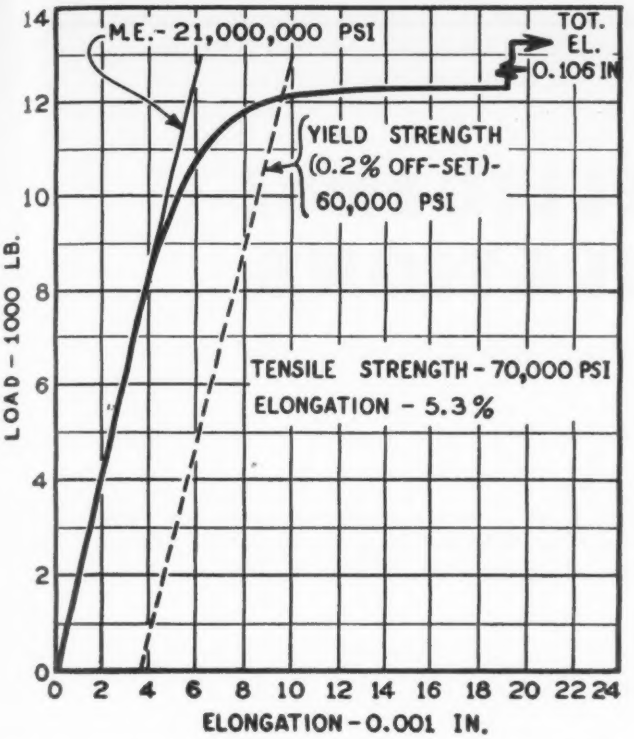


Fig. 7—Typical load-elongation curve, 0.505 in. dia. tensile bar, 2 in. gage length. Standard bolt metal.

rial machines somewhat better than a steel of the same hardness.

By reason of the copper content in solution in both bolts and nuts, the bolt-nut combinations are slightly but definitely cathodic to unalloyed iron or steel in a conducting environment. This is an important factor in corrosive services because the electrochemical corrosion currents will run generally from pipe to bolts and not in the reverse direction, so that the bolts in effect are protected cathodically.

Corrosion Resistance

In strong acids corrosion occurs more by direct chemical action and here, too, the standard bolts and nuts are more corrosion resistant than the plain iron with which they are used. The nuts are resistant by virtue of their copper content, and the bolts are more resistant by virtue of copper content and denser structure. Results of a typical test are shown in Table 2. In this test the unalloyed gray iron was sand cast in the shape of bolts and nuts in order to eliminate the effect of varying shapes of specimens and varying surface areas, and to make the test as far as possible a true comparison of materials.

Another typical accelerated corrosion test was made by bolting two plain cast iron bars (cast of normal pipe iron) together with four bolts and immersing in 2 per cent sulfuric acid for four days. The losses in weight of bolts and nuts in contact with plain cast iron were as follows:

Material	Loss in Weight, per cent Bolt	Nut
Steel	8.8	50.7
Pearlitic malleable	15.7	40.7
Standard Bolt Metal (1)	6.6	25.2
Standard Bolt Metal (2)	4.5	38.6

Presumably the greater resistance of the standard bolt metal is due largely to the 1¼ per cent of copper in solution.

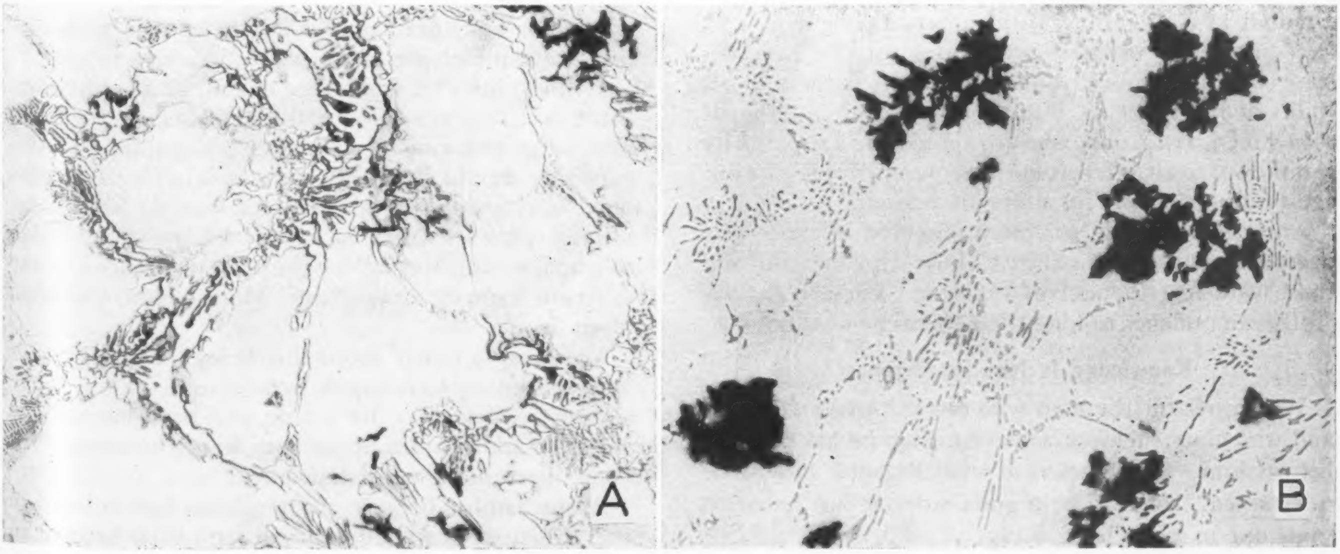
Austenitic Malleable Iron

A special development of the bolt process is the production of austenitic malleable bolts which are used for super-corrosive conditions, or where a higher degree of toughness and ductility is desirable. The metal used is compositionally a modified nickel alloy. The total carbon is kept low and the chromium on the high side. Desired average analysis in percentages is as follows: T.C., 2.30; Si, 2.00; Mn, 1.25; P, 0.10 (max.); S, 0.12 (max.); Ni, 15.0; Cu, 6.0; Cr 3.0.

This metal is melted in the same 24-in. cupola used for the standard bolt iron and is cast in metal molds on the same bolt turntable. Because of the chilling action of the metal molds this metal also casts white in

(Concluded on Page 62)

Fig. 8—Photomicrographs showing structure of austenitic malleable bolt metal. Etched in $FeCl_3$. X500. A—As-cast—carbides in austenitic matrix. B—Annealed—graphite (dark) and carbides (gray) in austenite matrix, producing a soft, tough malleable iron.



THE ROLE OF INTELLIGENCE IN OUR LABOR RELATIONS

E. B. Gallaher
Norwalk, Conn.

Part II of a paper reprinted from the Army Ordnance Association Business Letter of March, 1947. Part I appeared in August American Foundryman.

If you have to deal with people and wish to succeed in this world, you must acquire the ability to raise and lower your own level to the level of each individual you come in contact with and to do so instantly and so cleverly that he will be unaware of what you are doing; you must not be patronizing.

Every truly successful man in the country has this ability, more or less, and his success can be measured by the extent to which he practices it.

Assume that you are a top executive doing business with brainy men—leaders like yourself. I do not need to state that you must be at absolute ease when talking to them if you expect to do business with them as an equal. But how do you act when you happen to meet, say, a sweeper in your plant?

The answer could easily be obtained by asking this man what he thought of you. If the answer was that you are a great guy, you may be sure that you possess the "it" of success in your human relations. If, on the other hand, he said you were a puffed-up old snob, you may be sure there is lots for you to learn. You may not think so, in which case you should re-examine your own mentality—possibly you are misplaced.

This ability to raise and lower your level to the level of the man you are talking to is probably the greatest single asset a man can possess. We call it being "human," and you will find the bigger a man is the more human he will be.

This brings us to a consideration of the age of an individual in his dealings with others. Older men who have succeeded in their professions usually have become very human and understanding of others in all walks of life. Not so, unfortunately, with intelligent young men, as a group, who are apt to have a superiority complex—a trait often found in young people of average intelligence but for different reasons.

An inferior intellect is often observed in those who overestimate their own ability, those who are vain, and those who feel themselves superior. These traits are really camouflages to hide their inherent weaknesses.

Knowledge Is Not Intelligence

Watch out for the man who can not make decisions and who always temporizes, even when he has the facts before him. Such a person's intelligence should be questioned. He may be a good worker, but he needs some one to guide him.

Never lose sight of the fact that mature age and years of experience do not supply intelligence. As stated previously, a person's intelligence changes little during his entire lifetime. He may and often does acquire great knowledge along certain lines, but knowledge must not be confused with intelligence as it so often is.

We have a lot of men filling important executive positions who are absolutely misplaced; they lack the intelligence to manage others and to make prompt and effective decisions.

Such men often have worked up through the ranks, holding first one job, then another as head of a department, all the time acquiring a world of knowledge about the details of the business, but always, let it be noted, having some one over them making the decisions and guiding them. When vacancies develop at the top, they are often advanced to become leaders and assume full responsibility without any thought having been given to their mental capacity to fill the jobs. These are cases where knowledge and long experience have been mistaken for intelligence.

Adequate Mental Level

Again I state, you must have knowledge and experience, whether old or young, but you must also have a mental level adequate to fill a job which requires initiative and the ability to make right decisions.

While those who have the selection of men for executive positions are often badly confused in assuming knowledge and long service as being the same as intelligence, we should remember that those in the ranks who have worked side by side with the new appointee are often well aware of the fact that he lacks what it takes to manage and, especially, to inspire confidence in those who are to work under him. Here is where trouble often begins.

We hear so much about this being "a young man's age" that many have begun to believe that young men, simply because they are young and have lots of pep, should replace older, experienced men as executives. Nothing could be more dangerous.

Many assume because a young man had enlisted in the armed services, gone abroad, and even become an

officer, that he has become eligible for an executive job. As a matter of fact, he may have gained a lot of knowledge and experience along highly specialized lines, but his mental level is just the same now as it was when he joined the armed forces. The greatest disservice we can do to such young men is to place them in executive positions which they are mentally incapable of filling. It is easy to advance a man to a higher position, but it is hard to demote him without breaking his spirit.

Through at Sixty?

There is nothing more cruel and economically unsound than fixing an arbitrary age limit for executives. The theory is that a man who has reached the age of 60 or 65 should be retired to make place for a younger man. On the surface this seems all right, but it is certainly open to argument.

If the executive has not the capacity to manage properly, if he lacks the confidence and loyalty of his subordinates, his retirement is "good riddance to bad rubbish." But why wait, in such case, until he has reached a prescribed age limit? Manifestly he never should have been placed in such a position and should be promptly removed, even before the age limit is reached, if he lacks both intelligence and knowledge to inspire confidence in his plant or if his decisions are bad or, worse still, if he temporizes. A temporizer slows down the entire pace of any plant.

But how about a man who is highly intelligent, who has wide experience and a complete knowledge of the business, and who is recognized by all his subordinates as a capable leader? Should such a man be thrown on the dump at 60 years of age?

If such an executive's health is good, if he has a desire to keep on working, it is very questionable whether he should be asked to leave.

Outside of the knowledge and ability to manage possessed by such an executive, think of the loss there will be in the good will which he has attracted and is still holding for the benefit of the business should his job be turned over to another, even though his successor is competent to assume it.

Executives Need Technical Experience

Another dangerous procedure is to elevate men to top executive positions who have not had a thorough grounding in all the operations of the business.

I know of men who have advanced to the top through office positions or through sales promotion who have not even an elementary knowledge of production.

Often these men talk a lot about production, but their "knowledge" is all hearsay—they have never been in the shop, they have never had to manage workers who are producing, and they have no technical knowledge or even an aptitude for technical subjects and, consequently, little or no sympathy for the producers in the plant.

Such executives are severely handicapped as they must depend upon high-class subordinates for their success.

Labor troubles often develop in organizations where the chief executive does not know and is not in sympathy with his workers.

Reappraising, at regular intervals, the ability of everybody in the company is of great importance and pays handsome dividends.

The average man just works along until the whistle blows; then he goes home and forgets his job. Now and then, however, a man comes to his immediate boss with a good idea, and right at this point you have a man who will likely keep on having good ideas and who will advance rapidly in your organization. If mishandled, you will lose him, and some one else will profit.

Here is where the intelligence of the heads of departments comes in. If a department head is really intelligent, he will grasp at a new and better way of doing something and will encourage any one who makes good suggestions because it means that such a person is thinking about improving the business.

Watch out for potential foremen among your men—they are not always found to be your best producers as their minds may be working faster than their hands. They usually are fellows with lots of good ideas and very quick on the trigger. Such men, if they have the quality of leadership and an understanding of human nature, often make fine foremen.

Does Intelligence Guarantee Success

If your department heads have low intelligence, they also have an inferiority complex; they try to conceal their own ignorance and invariably will turn away any one who tries to criticize what they are doing or who offers new and better ideas. The intelligence of every department head should be carefully checked for more reasons than one, as will be discussed later. This is of extreme importance.

Is a man who admittedly possesses high intelligence and who has acquired great knowledge an assured success? By no means; he must have something else—humility and understanding of human reactions.

What good does it do to become highly educated, to have great mental capacity and a world of knowledge, if you can not pass this on to others and get them to work with you?

Unfortunately, there are many who possess most all virtues except the ability to be human and who therefore make those about them uncomfortable. Too often such persons have oversold themselves on their great ability, and they scintillate brilliancy to an extent that any one who comes in contact with them takes a permanent dislike to them.

Such a man should never be allowed to mix freely with your workers as he is a troublemaker. His ability may be necessary to you, but he should be segregated.

Responsibility of Management

Those of us who have the brains to plan and develop things can go ahead and plan all we like, but we can not get to first base without the help and cooperation of the remaining eighty-six per cent of human beings who must carry out our plans. The success or failure of our enterprise will depend entirely upon the amount of cooperation and confidence we can inspire in them.

If we are to assume leadership in the management of industry, we must realize that we have an obligation to labor and also to our stockholders to see that our plant is properly managed.

We all, I think, will agree to this. But how often do we find production stalled, with consequent lay-offs, because some one has failed to think things through or has miscalculated. In consequence we find ourselves lacking critical materials, parts, tools, or equipment to keep up a steady flow of our products through the plant. Both labor and those who have invested in our enterprises have a right to protest such conditions; yet most of our layoffs are due in part or in whole to this very condition.

When top management is approached on the subject, it invariably will blame the department head responsible for shortages due to lack of anticipation or planning. But how much better it would be if these top executives would themselves assume the blame for not having been more careful in selecting department heads who had the mental capacity to hold down their jobs.

Who Is to Blame?

Again, we find shop foremen in different departments ordering some special brand of material or some special tool, not realizing that there may be several brands of the same material or tools which are identical. We can not blame the foremen in this case, but how about the buyer who may order three or four complete stocks of identical material sold under as many brand names?

I recall one case where a concern had purchased $10,-000 worth of identical material from three suppliers under three brand names and, therefore, had three identical stocks on hand when one stock of a single brand costing $3,400 would have been ample to meet all requirements. The point is: why should the stockholders have been burdened with $6,600 worth of needless inventory?

The buyer, in this case, might plead that he bought what each foreman had requisitioned and that he did not know the stocks purchased were identical except for brand names. Well, how about his intelligence? Again, who is to blame in this case—the buyer or top management which allowed him to hold the job?

If the stockholders knew of the economic crimes which are being committed by top management, there would be many shake-ups, and men having more intelligence, as well as knowledge, would be placed in control. We would thus gain in efficiency. Right here is the partial answer to high-cost production.

Workers Belong to the Plant

Have you ever stopped to think to whom the workers of a plant belong? Do they belong to the plant and management or do they belong to a labor boss?

Of course you will say that they belong to the plant, as the plant gives them the opportunity to work and provides the tools, equipment, and the market for their products without which there would be no jobs available. You would be one hundred per cent right.

Then, if they are your "children," so to speak, why do not you, as the head of the household, study their requirements, their fears, and their ambitions and provide for them directly instead of allowing them, through lack of attention, to deal with you through a labor boss?

A good executive should never lose touch or personal contact with all the plant personnel. He should make it a point to visit the plant at frequent intervals, chatting with the foremen and the workers as he makes his rounds. There is nothing that builds up plant morale better. Executives who consider this as beneath their dignity should not be in their jobs.

As a matter of fact, a truly successful executive should have more than a general idea of the problems of production. He should know personally how his products are made and have a working knowledge of the tools required to make them. He should also know his men well enough to argue their problems with them.

In making your trips through the shop, it is better to go unescorted—your men will open their hearts to you when alone, but will not do so when others are around. You will learn much of value about your business from private talks with your workers, and you will build up valuable friendships in the plant which are of the greatest importance.

In the case of the executive who does all his directing from a fine office, with a desk clean of papers—who assumes a snappy, high-power air in his dealings with others—such a one lacks all the human virtues which go to make up a really great executive.

He may have the intelligence and the knowledge, but if he is not human nobody trusts him as he is too much wrapped up with his own importance. Unfortunately, there are lots of them, and where they exist we invariably find tension in the labor relations of that company.

Summary

Workers are human beings having varying degrees of intelligence and adaptability. They would rather do business with a sympathetic management. To work with them we must know them at first hand and do business with them on their own particular level.

Workers as well as stockholders have a right to demand that all executives and all department heads possess sufficient intelligence to perform their work properly and efficiently. Workers should not be forced to lose pay through layoffs due to poor planning and execution.

Stockholders should not be penalized through avoidable losses caused by unintelligent management, and they have a right to protest when cost of production is higher than it should be due to unintelligent handling.

Industry must assume the responsibility of keeping all our workers employed, no matter what their level of intelligence may be, and therefore should classify them according to mentality or adaptability; then classify jobs so that each worker will be required to perform to the maximum of his individual ability but no more.

We should realize that the security of the job is of more importance to the workers than the rate of pay, and it should be our aim to assure this security by every means in our possession.

We should provide some definite means for allowing workers of high intelligence to advance to better positions, when and if they demonstrate their ability.

We should not attempt to assume or be allowed to assume a position to manage others unless we can demonstrate that we possess as great or greater intelligence and have as much practical knowledge as those who are required to work under us. This applies equally to the boss, to every department head, and to all foremen, both in the shop and in the office.

MOLDING MACHINES

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Because of the diversity of size, and the varied requirements of machine-molded castings, manufacturers of molding machines are required to design, build and supply a great range of types and sizes of machines. Each design has its definite characteristics, the ability to perform certain operations, and also certain limitations.

There are approximately 63,000 molding machines in use in United States and Canada. About 20,000 are jolt squeezer molding machines. The other principal types consist of jolt rockover, jolt rollover, jolt stripper, jolt squeeze stripper and jolt rollover squeeze and pattern draw machines.

Jolt squeezer machines on match-plate work are somewhat a standard operation, but on many jobs some study is required to decide whether or not the job is of such a nature that it would be more efficient to produce it with cope and drag pattern equipment.

The size and design of the flask and castings, production requirements, type of co-ordinating equipment, and method of making the molds, generally establish the type and size of the machine. It is reasonable to assume that, when production runs are short, flexibility is desired to meet a range of flask sizes.

Either tight or slip flasks are used, and are fitted to run several different patterns, with considerable variations in size. In practically all cases bottom boards are used.

Patterns are made of wood or aluminum, and mounted on either wood, aluminum or cast iron plates, with provisions made for rapid pattern changes. Both cope and drag machines must be designed with suffi-

Installation view of jolt rollover pattern draw machine showing mold being butted off prior to the rolling over and drawing operation.

cient flexibility to meet these requirements. In some cases, portability of the machine is desired, especially when sand is to be shoveled by hand.

In foundries where high production is required on repetition work, speed of molding is of prime importance, with flexibility secondary. Pattern and flask equipment should be well designed and constructed.

The flasks should be designed to suit the patterns or a range of similar patterns, where conditions permit. Both the cope and drag flasks should be barred to eliminate the use of bottom boards whenever possible. Jolt squeeze stripping both cope and drag is the speediest molding operation, but this is limited to flasks of approximately 2,000 sq. in. of flask area (maximum).

For larger flasks, jolt stripping or jolt rollover pattern draw molding machines are generally used as problems of machine arrangement and mold handling becomes more involved. While all types of molding machines will produce molds, a thorough study of the class of work and a more familiar understanding of the characteristics of the machines will result in better production and a higher quality of castings.

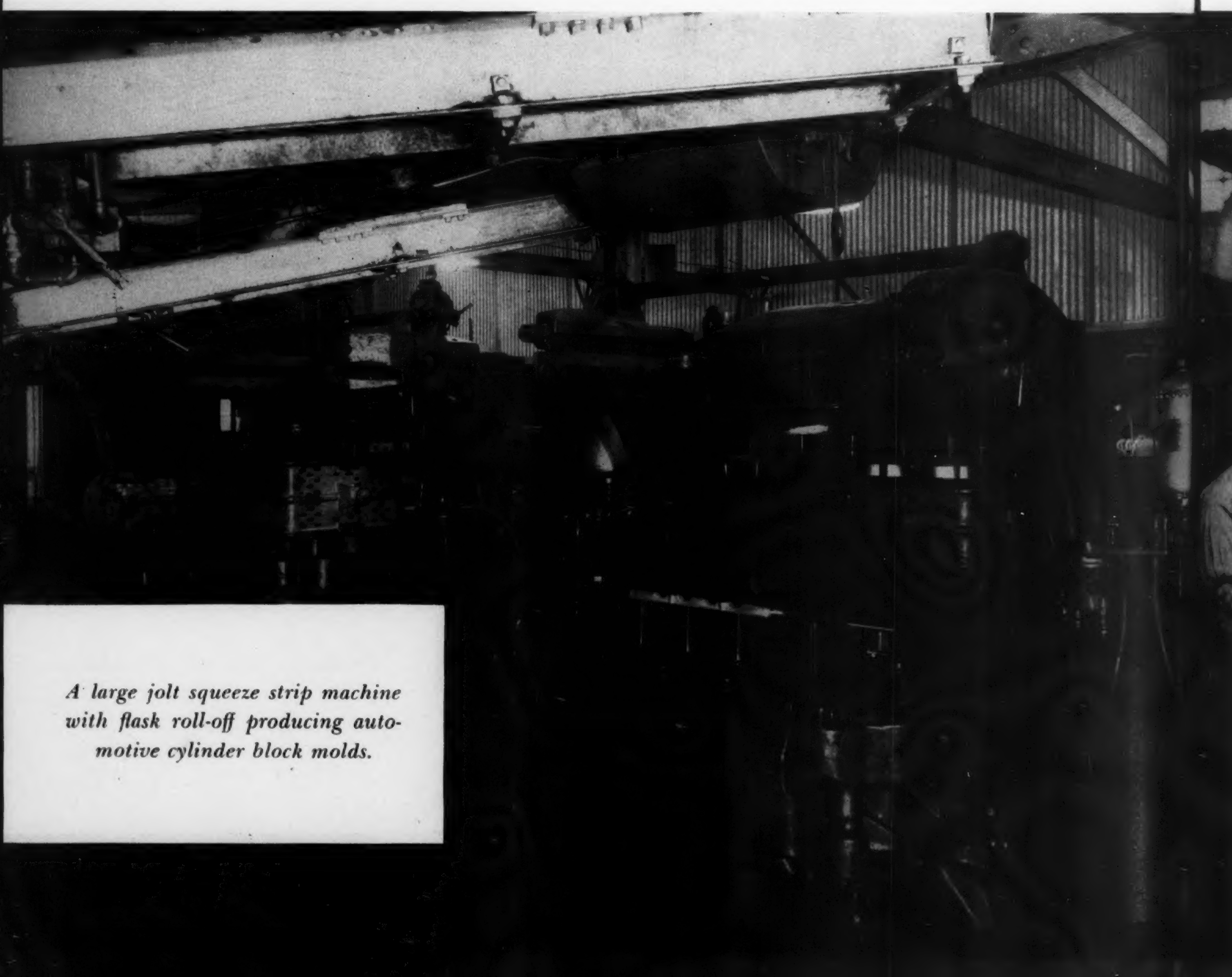
Jolt Squeezers

Machines of the jolt-squeezer type are available in either portable or stationary designs, with squeeze cylinder diameters of 10 to 18 in. The jolt on this machine is shorter and more rapid. A heavier jolt will spring a match plate during the jolt operation. The large 16 and 18-in. machines do have a harder jolt, and usually are used in steel foundries, where the heavier bonded sand requires a harder jolt. Match plates heavier than the standard thickness are recommended for these larger machines. The table height is important for ease of operation, 27 to 29 in. meeting this requirement. The 10-in. squeeze cylinder machine is the one most widely used at present, but the larger squeeze cylinder machines are coming into more extensive use due to the demand put on the foundries for greater precision in sand castings.

Jolt Rollover Pattern Draw

The rollover molding machine is designed to handle a range of flasks, from the small flask that is not too heavy to handle manually, up to those weighing several thousand pounds. Smaller machines are built in both portable and stationary types. Due to the open-end construction and the hinge type rockover principle, a large range of flask lengths and depths can be handled. The width range is confined because of the machine design. The table height on this machine is higher than that desired when rigged with deep flasks, but is designed and built as low as engineering principles will permit. Hand clamps or air clamps are available. Air clamps constitute the fastest clamping method, but require more time in adjusting for flask heights.

The rockover principle involves lifting the mold, pattern and rockover table through a 180° arc from the jolt



A large jolt squeeze strip machine with flask roll-off producing automotive cylinder block molds.

side to the draw side of the machine. Due to the high starting torque considerable power must be used, and when the mechanism reaches the apex of the arc this must be transferred to braking power to lower the mold to a position for the start of the draw. The operation must be made as rapidly and smoothly as possible and has involved considerable study in the design of the machine, especially for handling the heavier molds.

The hand power rockover machine for medium-size molds or cores is limited to approximately 200 lb. gross weight. The weight of equipment and mold should be checked before rigging on hand power rockover machines to be sure that capacity is not exceeded.

Hydraulic Draw

Draw mechanism should be well guided to prevent torsion during the drawing of the pattern. In the past few years the trend has been to the hydraulic principle of draw, rather than by air, as the fluid-type draw eliminates pulsation at the start of the draw, gives any desired speed of draw, and requires less adjustment when changing from heavy to light molds. The speed of operation on this type of machine is moderate; it offers a great range of flexibility where short runs of production castings are required, and has established its place in foundries of the jobbing and semi-production type.

The rollover molding machine differs from the rockover machine in that the mold is rolled practically on its own centers. It performs the same class of work as the rockover machines, but fits a range of molds of a larger size, namely, flasks from 4 ft square to approximately 6 by 12 ft. Capacities of the machine range from 3,000 to 15,000 lb.

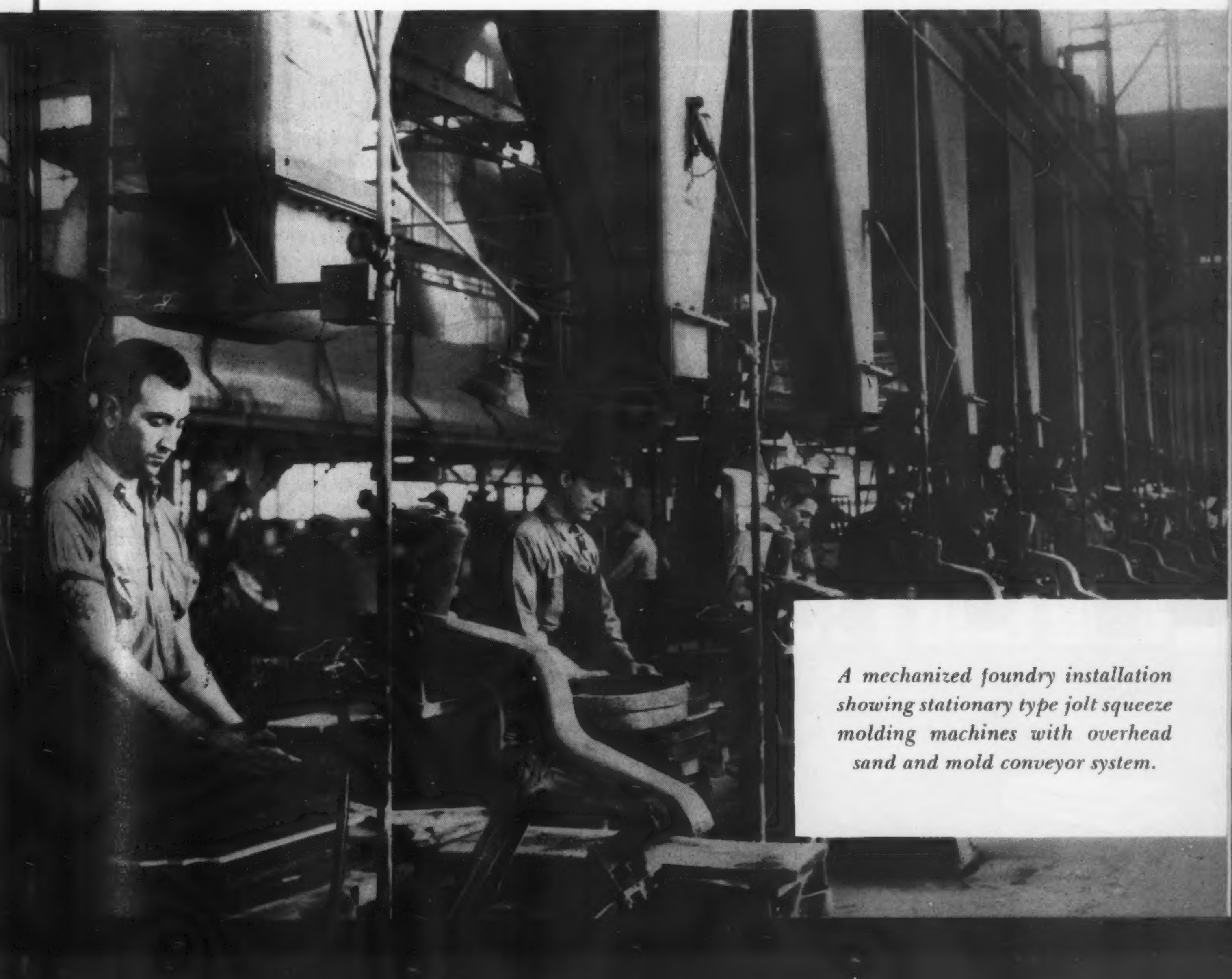
After the mold is jolted, butted off, and the bottom board clamped or secured, the mold is raised and rolled by power on the table trunions. The run-out car is moved under the mold, either manually or by power, the mold is lowered to the car and the draw takes place by power lifting the rollover table by its trunions. The mold is moved out to the end of the tracks, the rollover table unlocked and lowered to receive the next flask.

This machine has an accurate draw, due to the draw rods being at home in their bearings at the start of the draw. Exceptionally long draws can be made and the machine is normally fast for producing large molds.

Machine Limitations

With this type of machine there are some limitations, namely, length and width being limited due to the design. It is a pit-type machine, requiring substantial foundations. The machine is open front and rear, giving the operator room to work from either side and at a low working height, which is a distinct advantage. It is ideally suited for operations involving large and heavy machine molded castings.

This machine is designed as portable or stationary in smaller sizes, and stationary pit-type in larger sizes.



A mechanized foundry installation showing stationary type jolt squeeze molding machines with overhead sand and mold conveyor system.

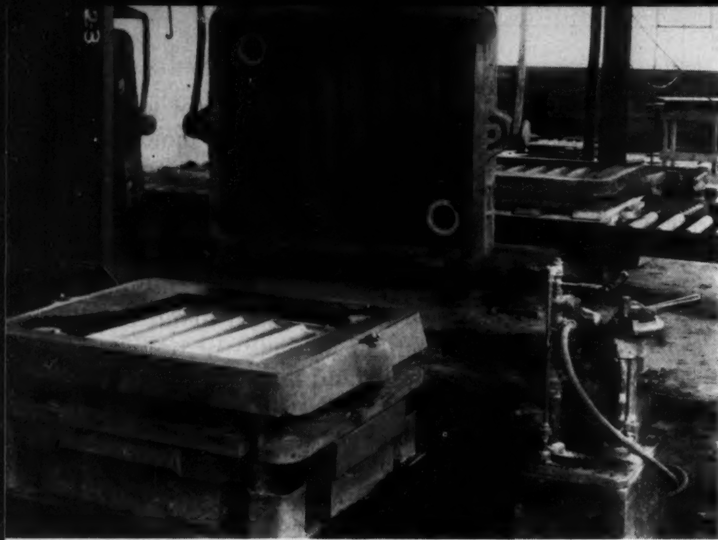


Table sizes range from 20 x 24 in. to approximately 4 x 7 ft. Capacities range from 500 to 10,000 lb.

The pin-lift type of draw has exceptional flexibility within its range. The hydraulic draw is used on some machines as it is smooth and steady, which is necessary on many cope molds. For the best jolting results, rigidly constructed metal patterns or metal pattern plates should be used wherever possible on all molding machines, as wood pattern plates act as a vibration dampner, and part of the jolt impact is absorbed in wood. In general, stationary jolt machines on good foundations ram better than portable machines. The smaller sizes of machines are well adapted to short-run jobs, and larger sizes perform equally as well in producing cope and drag molds, and for heavier and larger castings.

Jolt Squeeze Strip Machines

The jolt squeeze stripper is built in three different designs, with a range of sizes for each design—the lifting frame machine, the lifting frame machine with flask roll-out, and the pin-lift type. The lifting frame machine is built with squeeze cylinder diameters of from 14 to 33 in., and is primarily a high speed production machine. It is ruggedly built to stand up under production schedules upward of approximately 60 molds per hour.

Best results can be obtained with well designed and constructed pattern and flask equipment, and the machine served with overhead sand. The molds are first jolted and then squeezed. On the downward stroke of the squeeze piston, hold pistons engage the lifting frame. The pattern that is mounted on the jolt table is stripped down through the lifting frame, and the completed mold is removed by hand, or with bail and hoist to the conveyor. Then the valve is turned to neutral position and the lifting frame is lowered to receive the next flask.

Jolt Squeeze Strip With Roll-Off

All operations on the "jolt squeeze strip with roll-off" machine are identical with those of the "jolt squeeze strip" machine with the exception of placing the flask over the pattern and removal of the completed mold. Squeeze cylinder sizes are from 16 to 33 in. in diameter. Placing of the flask is done with the rollers in the up position and lowered over the pattern by dropping the rollers. The completed mold is rolled out through the machine where the set-off men remove it from the roll-

Left—Top to Bottom

A pit type jolt stripper molding machine for producing cope molds and a finished cope ready for closing.

Jolt rollover pattern draw machine showing finished mold on the run-out car after the mold has been rolled over and the pattern drawn.

A battery of jolt squeeze strip pin lift type molding machines in a mechanized malleable foundry having overhead sand and a continuous loop conveyor.

Stationary type jolt rockover pattern draw molding machine installation with overhead sand and roller conveyors. Machine at left has just completed a mold and is in the rolled-back position to receive next flask. Machine at right has just completed the draw operation and is in rolled-over position.

Squeeze Pressure Chart

Squeeze Piston Diam. (Inches)	Squeeze Piston Area (Sq. In.)	Total Effective Pressure Developed At Line Pressure of 80 Lbs. Per Sq. In. With Allowance For Average Load	Squeeze Pressure per Square Inch (80 Lb. Line Pressure at Machine)							
			25	30	35	40	45	50	60	70
			Area of Mold							
10	78.5	5700	228	190	163					
12	113.1	8300	332	276	237	208	185	166		
13*	132.7	9800	392*	326	280	246	218	196	163	
14	153.9	11200	448	374	320	280	249	224	187	160
15	176.7	12300	492	410	352	308	273	246	205	176
16*	201.1	14000	560	466	400*	350	311	280	233	200
18*	254.5	18000	720	600	514	450	400*	360	300	257
19	283.5	19800	792	660	566	495	440	396	330	283
20	314.2	22000	880	734	628	550	489	440	367	314
21*	346.4	23800	952	794	680	595	528	476	397*	340
24	452.4	31400	1256	1045	896	785	697	628	527	448
28	615.8	43500	1740	1450	1242	1174	966	870	725	621
30	706.9	49100	1964	1635	1402	1228	1090	982	817	701
33	855.3	59300	2372	1973	1690	1483	1316	1186	987	845
36	1017.9	70200	2808	2340	2006	1757	1560	1404	1170	1003

To use table, multiply length and width of mold to get area. Then find mold areas in above table nearest to your area. Squeeze piston diameters and pressures per square inch on mold can then be readily determined.

* *Examples:* A casting requires a flask 20 x 20 in. The area is 400 sq. in. If the casting is of aluminum a 25-lb pressure per sq. in. of flask area is sufficient. Reading down in the 25-lb column we find 392 area indicating a 13-in. piston, the minimum size to squeeze the mold to approximately 25 psi. If the casting is of brass or light gray iron, 35 psi minimum is required. Reading down in the 35-lb column we find 400 sq. in., indicating that a 16-in. squeeze cylinder is required for 35 psi. For a steel casting an 18-in. piston will develop 45 psi of flask area, and a 21-in. piston will develop approximately 60 psi.

out device. If the mold is a drag, it is placed on the conveyor. If it is a cope, it is closed over the drag mold. This type of machine is designed for high speed repetition work.

Patterns and flasks for this type of operation should be well constructed, as squeeze pressures with a minimum of 40 psi of flask area are recommended. In selecting machines for the job, the squeeze piston should be of sufficient size to give the required pressure.

Jolt Squeeze Pin Lift Machines

Machines of the "jolt squeeze pin lift" type are designed in various sizes, and those with squeeze piston diameters of 10 in. and up will produce practically the same range of work that the lifting frame type produces. With its adjustability for various sizes of flasks, it meets the requirements of a foundry engaged in producing such work as automotive or agricultural castings, where frequent pattern changes are made due to medium production runs. For this type of work, which might normally be run on jolt rockover and jolt stripper machines, a study of the job should be made to consider the possibility of running on jolt squeeze pin lift machines, as an improvement may be made in both quality and production. In most cases, the same pattern equipment can be used.

This machine is designed to meet the demand for high speed production of drag molds of such a nature that the mold must be rolled over before drawing the pattern. Several different sizes are made, with squeeze cylinder diameters from 13 to 24 in. The cycle of operations is as follows: when the flask is filled with sand, by a movement of the valve, the squeeze cylinder rises to a stop and a certain amount of the air is by-passed, entering the jolt cylinder and starting the jolt.

After the mold is jolted, the valve is turned to neutral, which stops the jolt and lowers the squeeze cylinder. The bottom or squeeze board is placed on the flask, the air clamps are locked, and the table and mold rolled over. The valve is turned to the squeeze position, the air clamps are unlocked, the mold is drawn from the pattern on the down stroke of the squeeze piston to a position on rollers where it is pushed through the machine by the operator's foot. The table is then rolled back to normal position to receive the next flask. The table height on this machine is too high for convenient hand-shoveled sand operation.

In producing molds on molding machines, in most cases, best results are obtained by a combination of the jolting and squeezing of the sand to the required mold hardness. Squeeze pressure for aluminum should be approximately 25 psi of flask area; for brass or light gray iron castings the pressure should be from 25 lb upward, depending upon the bond and flowability of the molding sand. For heavier gray iron castings, squeeze pressures should range from 35 to approximately 50 lb. For steel castings, squeeze pressures should be from a minimum of 40 lb for light castings upward to 70-75 lb. The prepared chart of cylinder diameters and areas gives the effective pressures on the flask area.

In general, considerable progress has been made in the design and construction of molding machines. The needs of the short-run production foundry have been considered and machines will be designed to meet their requirements. For the mechanized foundry on high production repetition work, the trend will be toward automatic or semi-automatic special machines to perform the complete operation from loading the empty flask to depositing the completed mold on the conveyor.

TWO YEAR EXHIBIT POLICY RECEIVES BOARD APPROVAL

REAFFIRMING THE Association exhibit policy which has been in effect since 1938, the A.F.A. Board of Directors voted unanimously at their annual meetings held in Chicago July 29-30 to stage foundry exhibits in conjunction with A.F.A. conventions not more frequently than every two years. (See pp. 21-22 of this issue for full report of the board meetings.)

Prior to 1936 the annual convention and exhibit of the Association came to be a widely accepted event, therefore the foundry industry as a whole looked forward with anticipation each year. However, existing business conditions in considerable part influenced the Association to consider in 1936 the staging of exhibits only on alternate years. Following the successful convention and exhibit at Milwaukee in 1937, and the Cleveland Foundry Congress and exhibit in 1938, the A.F.A. Directors approved staging the next exhibit after a period of two years. This policy has been followed ever since, and was reaffirmed at the Annual Board Meetings in July with the following resolution:

WHEREAS the American Foundrymen's Association in recent years has invited manufacturers and suppliers of foundry equipment and materials to exhibit their products and services at Annual Conventions of the Association at two-year intervals, and

WHEREAS the staging of A.F.A. exhibits biennially, maintained as a continuous practice since 1938, has come to be recognized as a real or implied policy of the Association, and

WHEREAS the Board of Directors of the American Foundrymen's Association believes it to be to the best interests of the Association, the exhibitors and the foundry industry as a whole to continue this exhibit practice, now therefore be it

RESOLVED, that this Board of Directors of the American Foundrymen's Association approves and establishes as a stated policy the staging of foundry exhibits at intervals not more frequently than every two years, and recommends that this policy be reaffirmed by successive Board of Directors of the Association.

APPROVED
MAX KUNIANSKY,
President
For the Board of Directors American Foundrymen's Association.

As a result of this action the Board of Directors found it impossible to accept the invitation of the California chapters to stage a combined convention and exhibit on the West coast in 1949. Because of the great distances between A.F.A. chapters on the Pacific coast, it has been felt that any annual meeting of the Association held there should be coupled with an exhibit of foundry equipment and supplies. With five A.F.A. chapters now organized on the coast, including some 10 per cent of the membership, it is likely that a foundry convention and exhibit may be staged at either San Francisco or Los Angeles in the near future, in accordance with the newly affirmed resolution of the Board.

RESEARCH PROJECTS FOR THREE A.F.A. DIVISIONS UNDER WAY

SINCE ITS INCEPTION the A.F.A. has followed a consistent policy of investigating problems and disseminating information for the benefit of all its members. Beginning on a modest scale, the scope of the Association's activities in this respect has broadened with the years and with the power and prestige inevitably accruing through the accumulated experiences freely contributed by practically all the prominent men engaged in the foundry industry.

Standards Raised

As a result the material collected and correlated has been responsible for raising the general standard of foundry knowledge. Consequently, thousands of foundrymen, denied through lack of time, opportunity or through force of circumstances, the benefits of a scientific education, now carry on their operations fortified by a working knowledge of the basic principles involved.

Now to aid to a great extent the old hit-or-miss, cut-and-try methods the Association is embarking upon a series of research programs directed to the pursuit of the more specialized and in many instances, obscure features which still persist and elude a definite solution.

Three projects have been approved by the A.F.A. Board of Directors and invitations to bid on two of the projects have been mailed to a number of institutions.

The project of the brass and bronze division involves a study of the fracture test as an indication of the quality of tin bronze. It is desired that the results of this research provide a satisfactory basis of interpreting the fracture test and thereby supply an inexpensive, rapid and dependable test to serve as a measure of the quality of molten bronze before it is tapped from the furnace. It is anticipated that the research will be conducted on two tin bronze alloys of composition of 88 percent copper, 8 percent tin and 4 percent zinc, and a second alloy containing 85 percent copper, 5 percent tin, 5 percent zinc and 5 percent lead.

By the establishment of a suitable design for the test specimen, choice of casting conditions, and proper control of the method for fracturing the specimen, it is anticipated that a test may be devised whereby the quality of tin bronze may be qualitatively determined before the castings are poured. This problem although of a practical control nature, is expected to reveal considerable information on the metallurgy of bronze.

Malleable Project

The second division to submit a proposal for approval by the National Board of Directors was the malleable group. Their research project committee stressed the need for a fundamental study to establish the most suitable microstructure for pearlitic malleable iron castings preparatory to selective hardening

(Concluded on Page 83)

CAST STEELS

Recent Developments Concerning Properties

Charles W. Briggs
Technical and Research Director
Steel Founders' Society of America
Cleveland

In this issue, the first installment of the paper originally presented before the Semi-Annual Meeting of ASME in Chicago, June 16-19, 1947. The second and concluding installment will appear in the October issue.

DURING THE PAST TWO YEARS considerable information has been developed on the properties of cast steels. The studies were formulated by the Steel Founders' Society, and the investigations were carried on at Carnegie Institute of Technology, Case School of Applied Science and Michigan College of Mines and Technology, under the direction of the metallurgical and mechanical engineering department staffs of these schools.

Cast steels selected for study were compositions produced by commercial steel foundries for production steel castings. The steel for test was in most cases taken from a production heat. In some cases an entire heat was used to prepare the necessary coupons.

Research studies were made in order to obtain correlated information on the properties of cast steels so that engineers, designers and the manufacturers of steel castings would be more familiar with the engineering properties of steel castings.

Interested in Properties

Purchasers of steel castings and their engineers are always interested in the mechanical properties of low-alloy cast steels, especially those properties which may be developed through the quench-and-temper heat treatments. This is understandable, since during the war the steel casting industry quenched and tempered castings of various sizes and degrees of complexity. Interest in notched-bar impact properties is continuing, especially at low temperatures, not only because of equipment operating under these conditions but low temperature impact testing gives an indication of what may be expected when parts operate at high speeds under impact.

Purchasers' metallurgists are likewise interested in hardenability of cast steel, time-temperature transformation curves for cast steel, and austenite grain size of cast steel, especially in knowing how these properties of cast steels compare with those of wrought steels. Also since engineers invariably place requirements on heat-treating operations in purchase specifications, certain information on the heat treatment of cast steels is valuable, especially if it can alter certain misconceptions. Information on all of these items will be presented in the following pages.

Since individual test data would cover numerous pages of this report, it is omitted and only summarizing curves are illustrated. Substantiating data are available at the universities conducting the tests. Also procedures conform to standard methods promulgated by the American Society for Testing Materials.

Properties of Low-Alloy Cast Steels

Cast steels can be produced in all the chemical ranges available to wrought steels, as well as several others which do not lend themselves to rolling or forging techniques. In fact, prior to the war, more than 60 types of alloy cast steels were produced by the steel casting industry to meet the requirements of purchasers. However, in recent years the trend in the industry has been toward producing cast steels to meet certain minimum mechanical properties rather than to produce steels to chemical ranges such as the SAE or AISI tables of steels. This trend started before the war and has continued.

The ASTM specifications for property requirements, as shown in Table 1, are becoming much more widely used. Most of these property values can be obtained by alloy cast steel containing but small percentages of alloying elements.

Most property values for cast steels reported in the literature show the use of one or two alloying elements in quantities of 1.50 to 3.50 per cent each. It is the thought of purchasers that relatively large amounts of

TABLE 1—ASTM SPECIFICATIONS FOR STEEL CASTINGS

	Mechanical Properties—Minimum			
Class	Tensile Strength, psi	Yield Point, psi	Elongation in 2 in., per cent	Reduction of Area, per cent
		A27—46T		
60–30	60,000	30,000	24	35
65–30	65,000	30,000	20	30
65–35	65,000	35,000	24	35
70–36	70,000	36,000	22	30
		A148—46T		
80–40	80,000	40,000	18	30
80–50	80,000	50,000	22	35
90–60	90,000	60,000	20	40
105–85	105,000	85,000	17	35
120–100	120,000	100,000	14	30
150–125	150,000	125,000	9	22
175–145	175,000	145,000	6	12

Table 2—Chemical Composition of Low-Alloy Cast Steels

Grade of Steel	Composition Specified, per cent				
	C	Mn	Cr	Ni	Mo
NE 1330	0.27–0.33	1.35–1.70	—	—	—
NE 8030	0.27–0.33	1.00–1.30	—	—	0.10–0.20
NE 8430	0.27–0.33	1.30–1.60	—	—	0.30–0.40
NE 8620	0.17–0.23	0.70–0.90	0.40–0.60	0.40–0.70	0.10–0.20
NE 8630	0.27–0.33	0.70–0.90	0.40–0.60	0.40–0.70	0.10–0.20
NE 8640	0.37–0.43	0.70–0.90	0.40–0.60	0.40–0.70	0.10–0.20
NE 8730	0.27–0.33	0.70–0.90	0.40–0.60	0.40–0.70	0.25–0.35
NE 9430	0.27–0.33	1.00–1.30	0.20–0.40	0.40–0.70	0.08–0.15
NE 9530	0.27–0.33	1.30–1.60	0.40–0.60	0.40–0.70	0.30–0.40

Silicon 0.40 to 0.60 per cent, phosphorus 0.05 per cent maximum, sulphur 0.06 per cent maximum.

alloy are needed to produce alloy cast steels of greater than average mechanical properties.

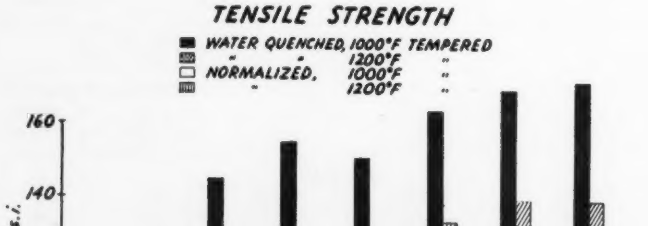
In order to illustrate the advantages of the use of alloy steels with small percentages of alloying content, a cooperative study was undertaken by 30 steel foundries, under the auspices of Steel Founders' Society working in collaboration with Carnegie Institute of Technology. These lean alloy steels were produced by adding from one to four alloying elements, representing combined additions of only 0.70 to 2.00 per cent. The N.E. number series were prefixed to these steels though all the manganese and manganese-molybdenum series were produced regularly in substantial quantities by the steel foundry long before the N.E. series were devised.

The properties listed represent the mode of distribution curve or values that would normally be expected in the production of low-alloy cast steels. These values act as reference points to help the designer and purchaser of steel castings to select the proper steel.

In order to be able to report property values that would be absolutely representative of commercial steel for castings, some open-hearth foundries produced heats upward of 35 tons from which the necessary coupons were obtained for the test studies.

This study was conducted on a regular manufacturing basis in order that the production and heat treatment of the steels should reflect commercial conditions

Fig. 1—Chart showing the tensile strengths of typical low-alloy cast steels used in the study—similar carbon contents with various heat treatments.



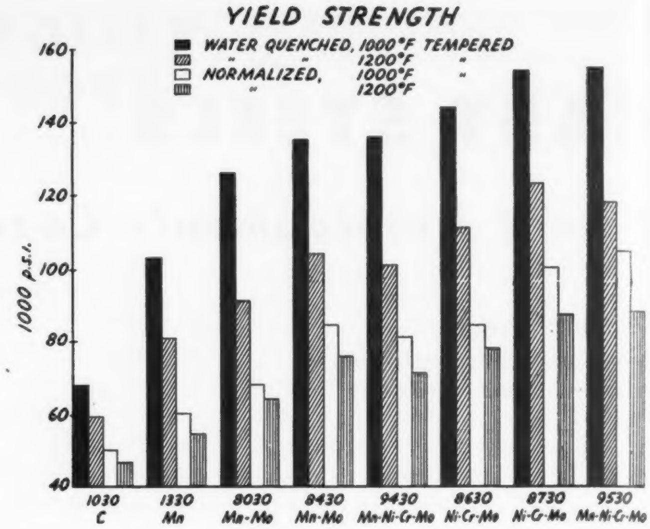


Fig. 2—The yield points of typical low-alloy cast steels of approximately 0.30 per cent carbon content.

rather than those obtained by precise laboratory control. Thus, while the mechanical testing procedures were precise, there was some spread in the data, as would be normally expected from commercial operations. The results obtained, regardless of the methods used to make the steels, were combined and average property values were computed.

Chemical Ranges

Chemical ranges of the low-alloy cast steels are listed in Table 2. The steels were produced by standard melting practices normally used by the foundries which produced them. The austenite grain size of all the steels produced to the compositions shown in Table 2 was from 5 to 8.

The popular heat treatments of (1) normalizing, followed by tempering and (2) water quenching, followed by tempering, were employed to enhance the mechanical properties of the low-alloy cast steels.

The great amount of tensile property data collected on all heats of the various classes of steel is presented in block diagram form for rapid visual examination and comparison. All test studies were made at Carnegie Institute of Technology. It was reported by the staff of the Institute that "the consistency of results indicates that two tests are almost always sufficient" to establish the mechanical properties of each heat of steel for any particular section thickness.

Tensile strengths of the steels studied are shown in Fig. 1. It will be noted that there is a gradual increase in properties with changing of composition from a medium manganese steel to the manganese-nickel-chromium-molybdenum steel, with tensile properties varying from about 100,000 psi to 160,000 psi, depending upon the heat treatment. Low-alloy steels having a 0.30 per cent carbon content were selected as the basis of comparison, since cast steels of about this carbon content are most commonly produced in the industry. Normal tensile strengths for a plain (unalloyed) carbon steel are also included for comparative purposes, since its properties are known to engineers and designers.

It is noteworthy that there is a relatively small spread

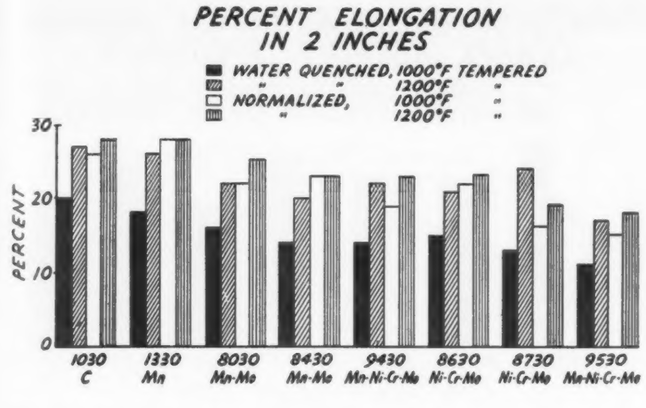


Fig. 3—Effect of heat treatment on the elongation of low-alloy cast steels of similar carbon contents.

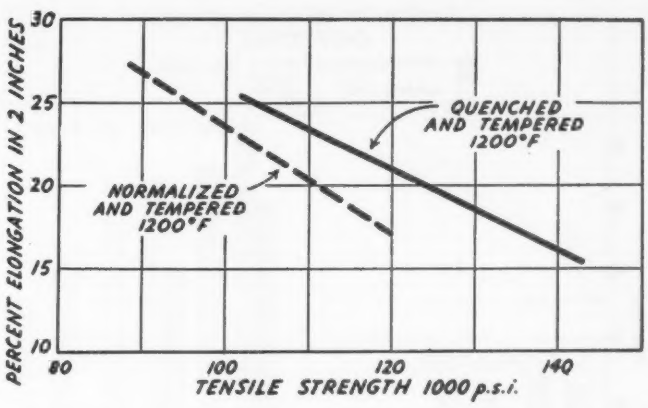


Fig. 5—Effect of heat treatment on the ductility of 0.30 per cent carbon low-alloy cast steels.

in the properties of the various low-alloy cast steels when normalized, followed by a temper heat treatment at 1200 F.

Figure 2 shows graphically the yield point values that may be obtained from the low-alloy cast steels in response to various heat treatments. These values are found to correlate closely with the tensile properties, as would normally be expected. In Table 3 are given the ratios between the yield and tensile strengths of the various low-alloy cast steels. The general average for the low-alloy steels is compared with the ratio normally obtained for carbon cast steel of similar carbon content. The yield-tensile ratio of 0.84 to 0.88 for quenched and tempered steels is considered excellent.

Ductility Values

Ductility, as measured in terms of percentage elongation in a 2-in. gage length, of the low-alloy cast steels is shown graphically in Fig. 3. The results are fairly uniform for all of these steels, and the elongation values of 10 to 15 per cent for quenched and tempered steels having tensile strengths of 155,000 to 165,000 psi are considered excellent.

Fig. 4—Graphs showing the reduction of area of certain low-alloy cast steels of similar carbon contents with various heat treatments.

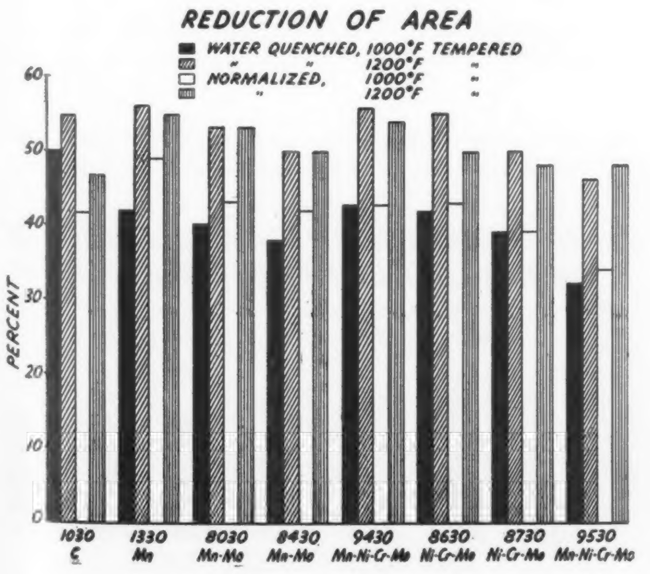


Table 3—Yield-Tensile Strength Ratios for Low-Alloy Cast Steels

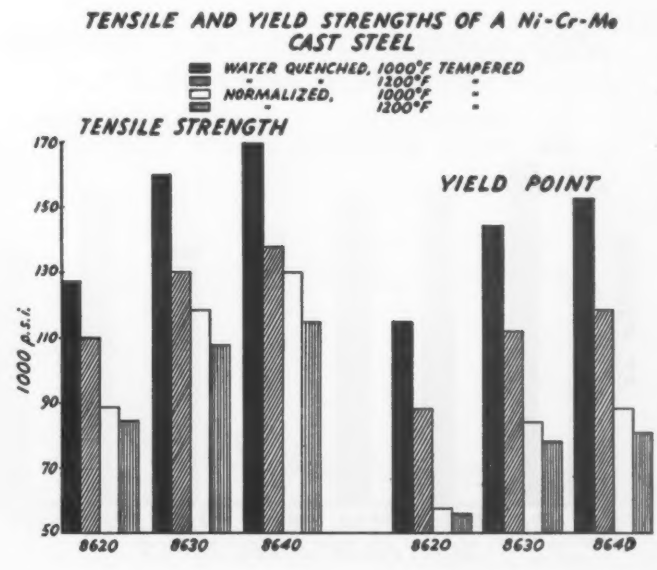
	Yield-Tensile Ratio			
	Water Quench		Normalize	
Steel	1000 F Temper	1200 F Temper	1000 F Temper	1200 F Temper
1330	0.82	0.78	0.60	0.60
8030	0.87	0.82	0.66	0.67
8430	0.88	0.85	0.72	0.73
9430	0.90	0.84	0.71	0.70
8630	0.89	0.84	0.71	0.72
8730	0.91	0.89	0.80	0.77
9530	0.91	0.86	0.82	0.77
Avg.	0.88	0.84	0.72	0.71
1030*	0.69	0.68	0.60	0.59

*0.30 per cent plain carbon cast steel.

Reduction of area values are shown graphically in Fig. 4. Values of about 50 per cent or over can be expected for quenched low-alloy cast steels when followed by a tempering treatment at 1200 F.

Factors affecting toughness are shown graphically in

Fig. 6—Graphs showing the effect of carbon content on the strengths of a Ni-Cr-Mo cast steel (8600 type) after various heat treatments.



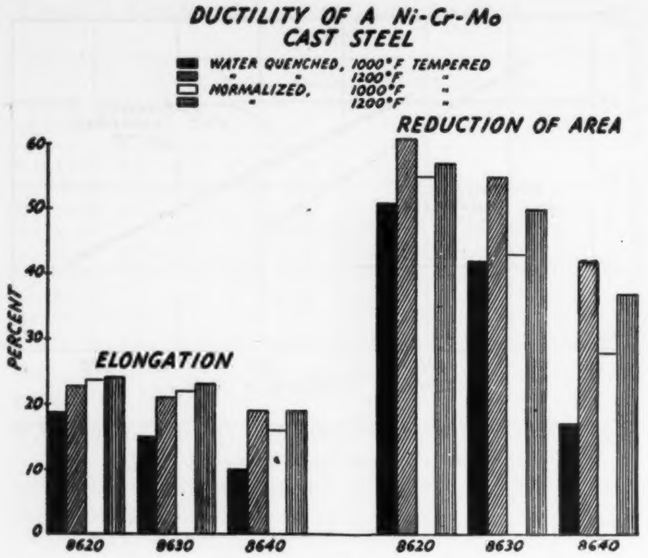


Fig. 7—The ductility of a Ni-Cr-Mo cast steel of varying carbon contents and heat treatments.

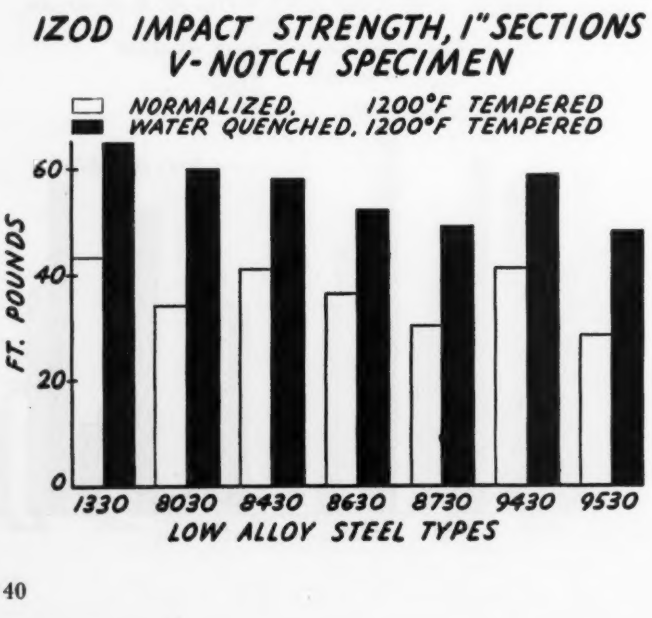
Fig. 5 by plotting the elongation values in relation to the tensile strengths. Quenching produces better ductility in a steel having a given tensile strength than does normalizing.

It is well known that the carbon content of a steel affects its mechanical properties. This is also true of the low-alloy cast steels, as shown graphically in Figs. 6 and 7. Normally, steels for the production of castings have carbon contents ranging from 0.20 to 0.45 per cent. Figures 6 and 7 illustrate the range of properties that can be obtained for one low-alloy steel (Ni-Cr-Mo). Similar ranges can be obtained for the other low-alloy cast steels.

Comparison With Wrought Steels

Figures 1 to 7 can be used to compare with similar data which the engineer has acquired for wrought steels. In general, the tensile strengths of cast steels are slightly higher than for corresponding wrought steels. However, the differences are slight (see typical examples of data on wrought steels given in Table 4), and can be accounted for by the higher contents of manganese and silicon normally present in cast steels.

Fig. 8—The Izod impact strength of typical low-alloy cast steels with two types of treatment.



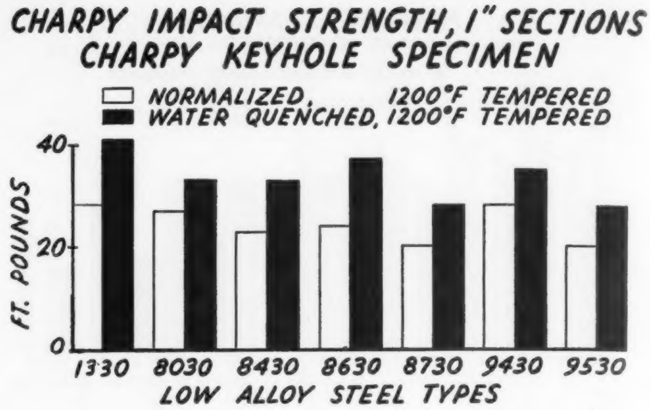


Fig. 9—Graphs showing Charpy impact strength of typical low-alloy cast steels.

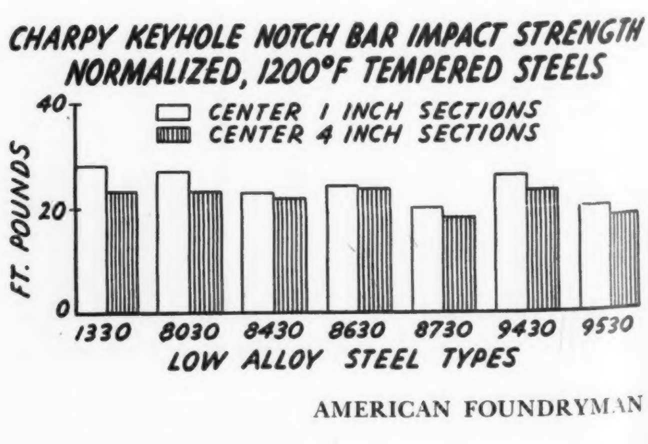
Table 4—Some Data on Wrought Alloy NE Steels for Comparison With Figs. 1 to 7

	Tensile Strength, psi	Reduction of Area, per cent
Wrought NE 8630 Normalized, 1000 F	96–102,000	58 to 63
Wrought NE 8630 Normalized, 1200 F	88– 94,000	62 to 66
Wrought NE 8630 Quenched, 1200 F	118–122,000	64 to 68
Wrought NE 9430 Quenched, 1200 F	109–120,000	63 to 66

Based on the data in Table 4, the cast steels have lower ductility values than the corresponding wrought steels. However, the wrought steel values reported are for specimens taken parallel to the direction of rolling; specimens perpendicular to the direction of rolling give considerably lower ductility values. For example, a wrought steel having values of 60 to 65 per cent reduction of area in the direction of rolling would have only 33 to 38 per cent reduction of area transverse to the direction of rolling.

Averages of these values are only slightly different from those of cast steels in which properties do not vary

Fig. 10—Charpy impact strength of normalized and tempered low-alloy cast steels—1 and 4-in. sections.



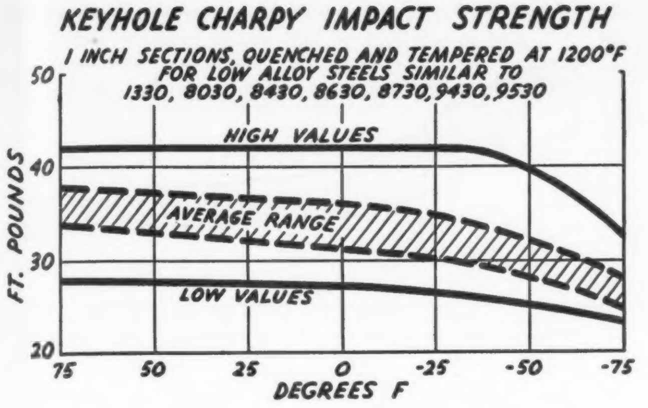


Fig. 11—Graph showing Charpy impact strength of low-alloy cast steels at low temperatures.

according to the manner in which specimens are taken. The fact that cast steel does not have directional properties—greater in one direction, less in another—is a matter of great significance and importance to designers of products in which uniform properties are desirable.

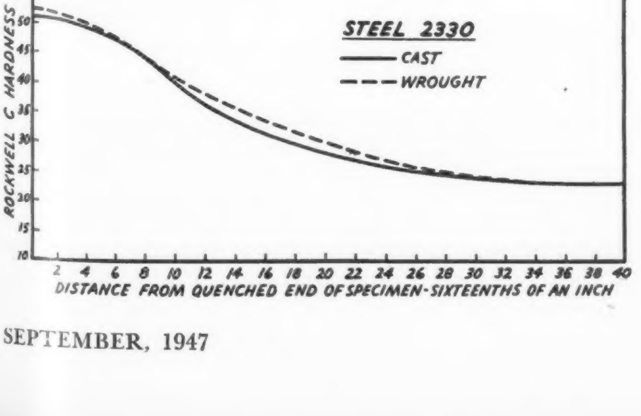
The notched-bar impact values for low-alloy cast steels are shown graphically in Figs. 8 and 9. In general, the variation from grade to grade is not great, but does show a tendency for impact strength to be high when ductility is high.

Figure 10 shows graphically the Charpy keyhole notched-bar impact strengths of low-alloy cast steels which were normalized, followed by a temper of 1200 F, bars having been machined from the center of 1 and 4 in. cast steel sections. It is of considerable interest to the designer that little variation exists between the two values, which means that steel castings of heavy section have notched-bar impact properties similar to castings of light wall section.

The low-alloy cast steels have excellent notched-bar impact properties at low temperatures, as shown graphically in Fig. 11. In this figure the impact data for all the low-alloy steels were averaged to indicate a high and low range of values. The values normally expected

Fig. 12—Comparative hardenability curve for cast and wrought steels similar to 2330:

	C	Mn	Ni	Grain Size
Cast	0.28	0.69	3.30	7–8
Wrought	0.29	0.61	3.41	7



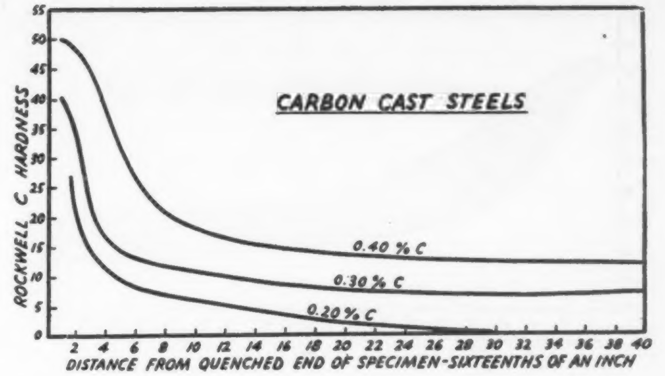


Fig. 13—Hardenability curves for typical carbon cast steels. Grain size 5 to 9.

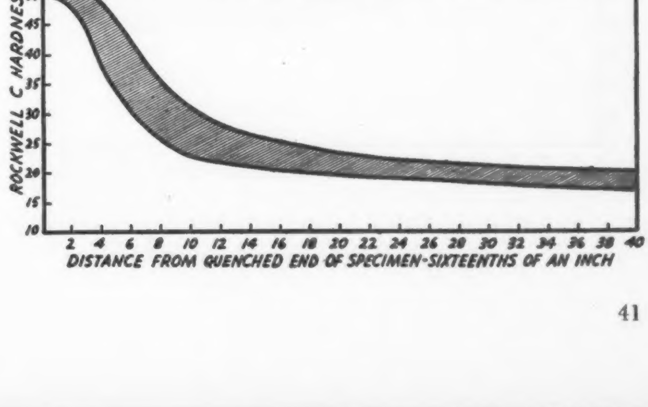
for the low-alloy steels are indicated by the band labeled "average range." Figure 11 shows that the impact values, as measured at room temperature, do not fall off materially at temperatures as low as —75 F, practically no change taking place until a temperature of —25 F is reached.

Figures 8, 9, and 11 show another advantage of quenching. It produces better impact strength values than normalizing. Increasing the tempering temperature from 1000 to 1200 F usually gives an appreciable improvement in notched-bar impact strength. Additional tests indicate higher impact strengths for the quenched steels over the normalized steels at both tempering temperatures.

Figure 11 also shows that the low-alloy cast steels retain most of their resistance to impact at temperatures as low as —75 F. This is usual in the case of cast alloy steels, as contrasted with plain carbon cast steels.

Because of the many variables involved and the lack of agreement in application of results, it is hazardous to attempt quantitative comparisons of notched-bar impact properties. However, the general statement may be made that although low-alloy cast steels tend to have slightly lower indicated impact strength than their wrought steel counterparts, this slight difference is not indicative of their probable relative performance in actual industrial application. This is particularly true since impact values that have been reported for specimens taken transverse to the direction of rolling, or to the direction of forging flow lines, may be as little

Fig. 14—Hardenability band for alloy cast steel 1330 (medium manganese). Grain size 5 to 9.



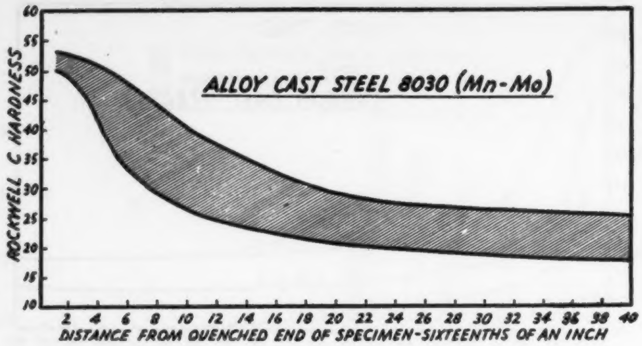


Fig. 15—Hardenability band for alloy cast steel 8030 (Mn-Mo). Grain size 5 to 9.

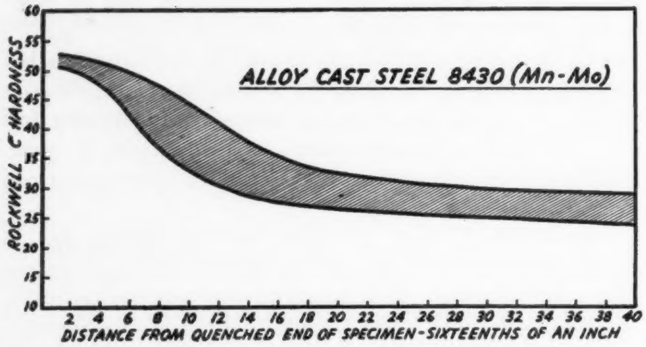


Fig. 16—Hardenability band for alloy cast steel 8430 (Mn-Mo). Grain size 5 to 9.

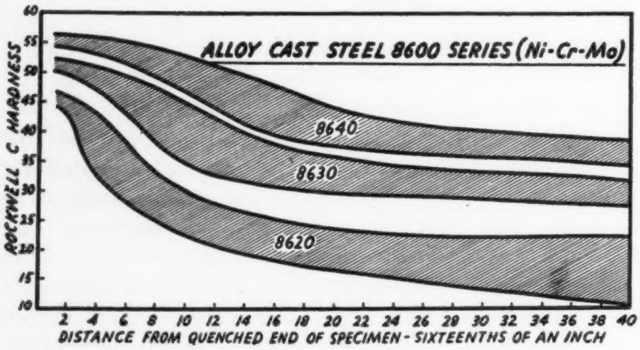


Fig. 17—Hardenability band for alloy cast steel 8620, 8630, and 8640 (Ni-Cr-Mo). Grain size 5 to 9.

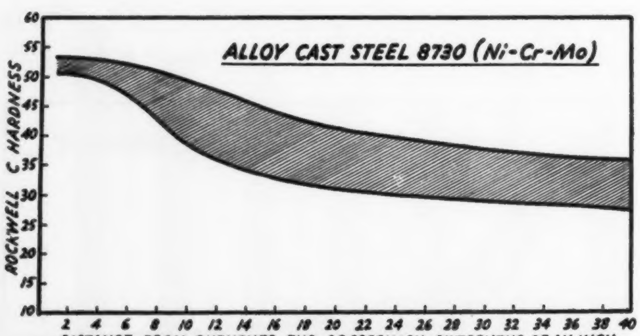


Fig. 18—Hardenability band for alloy cast steel 8730 (Ni-Cr-Mo). Grain size 5 to 9.

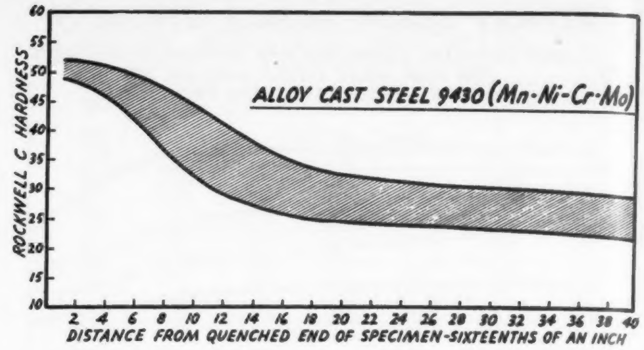


Fig. 19—Hardenability band for alloy cast steel 9430 (Mn-Ni-Cr-Mo). Grain size 5 to 9.

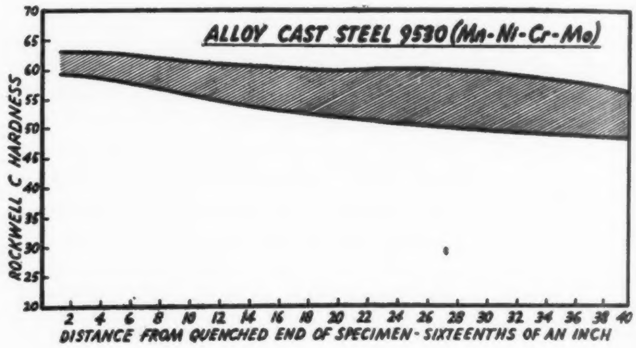


Fig. 20—Hardenability band for alloy cast steel 9530 (Mn-Ni-Cr-Mo). Grain size 5 to 9.

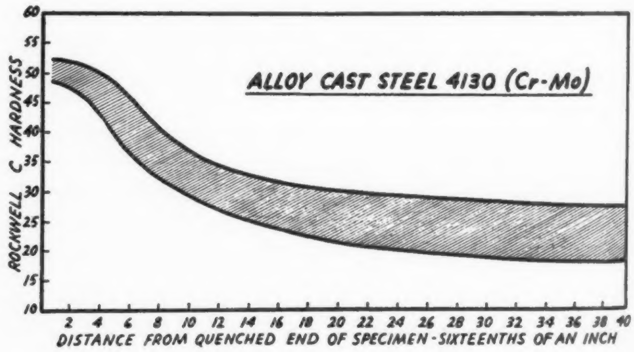


Fig. 21—Hardenability band for alloy cast steel 4130 (Cr-Mo). Grain size 5 to 9.

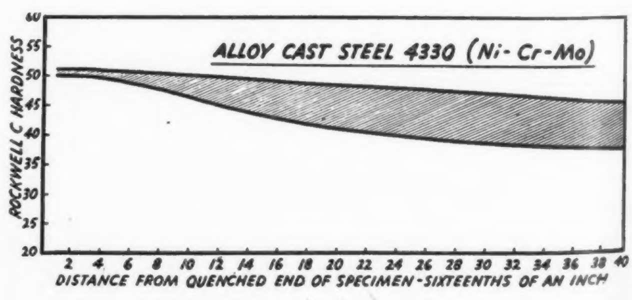


Fig. 22—Hardenability band for alloy cast steel 4330 (Ni-Cr-Mo). Grain size 5 to 9.

Table 5—Comparison of End-Quench Hardenability of Cast and Wrought Steels

Grade	Distance from Quenched End to 50 Per Cent Martensite in 1/16 In.	
	Cast Steel	Wrought Steel
NE 8620	3½ –7	2– 6
NE 8630	7 –13	4– 9
NE 8640	11 –19	5–13

as half the value of those reported for specimens taken parallel thereto.

The ability of steel to harden upon quenching has long been recognized as one of its most valuable properties. It is known that when steel is heated to the proper temperature and quenched, the hardness of the steel depends upon the speed of the quenching process—the more rapid the quench, the higher the hardness. Thus a study of the manner in which a steel hardens when applying different cooling rates indicates the degree of hardenability obtainable.

The term "hardenability" as applied to any particular steel embraces two basic principles: (1) quenching develops a maximum hardness; and (2) there is a limit to the section size which will be completely hardened upon quenching. The degree of hardness attainable increases with the carbon content of the steel. The maximum hardness obtainable is not significantly affected by the presence of alloy contents up to approximately 5 per cent.

The end-quench hardenability test has made it possible to predict the depth to which a particular steel can be hardened by applying a specific quenching rate. The test is simple, easy to perform and remarkably consistent and accurate in its results. Approved procedures for conducting the tests have been published.

Steel castings that have received a quench-temper heat treatment are daily gaining greater favor among engineers. During World War II, large quantities of steel castings, ranging from simple to complex shapes, were given routine quench and temper heat treatments. Although quenching and tempering should not be applied to some steel castings, because of large variations in sectional thickness or too complicated design, nearly all steel castings can be heat treated in this manner.

A section may be considered hardened throughout for most commercial purposes when it has a microstructure of 50 per cent martensite at the center. The best combination of strength, ductility and toughness, as measured by resistance to impact, is produced in cast steels by quenching and tempering treatments.

It should be remembered that the maximum mechanical properties attainable from quenching and tempering cannot be secured in a partially hardened section. For example, if a cast steel is of such a composition that, upon quenching, it will just harden throughout a one-in. section, any section larger than one in., when similarly quenched, will have an unhardened center. The thicker the section, the greater will be that portion of the section not completely hardened, with the result that the average mechanical properties will be lower than the maximum potential properties of the steel.

The factors which limit the depth to which a steel will harden are: (1) the severity of the quench; (2) the sectional thickness of the casting, and (3) the influence of chemical composition and grain size. The third factor, which determines the inherent response to hardening, is the characteristic of steel known as hardenability. The severity of quench is expressed in terms of the diameter of a round section of steel which will just harden through under the most severe quenching.

Table 6—Chemical Composition of Cast Steels Used for Hardenability Studies

Grade of Cast Steel	Composition Specified, Per Cent				
	C	Mn	Cr	Ni	Mo
1020	0.17–0.23	0.55–0.80	—	—	—
1030	0.27–0.33	0.55–0.80	—	—	—
1040	0.37–0.43	0.55–0.80	—	—	—
1330	0.27–0.33	1.35–1.70	—	—	—
8030	0.27–0.33	1.00–1.30	—	—	0.10–0.20
8430	0.27–0.33	1.30–1.60	—	—	0.30–0.40
8620	0.17–0.23	0.70–0.90	0.40–0.60	0.40–0.70	0.10–0.20
8630	0.27–0.33	0.70–0.90	0.40–0.60	0.40–0.70	0.10–0.20
8640	0.37–0.43	0.70–0.90	0.40–0.60	0.40–0.70	0.10–0.20
8730	0.27–0.33	0.70–0.90	0.40–0.60	0.40–0.70	0.25–0.35
9430	0.27–0.33	1.00–1.30	0.20–0.40	0.40–0.70	0.08–0.15
9530	0.27–0.33	1.30–1.60	0.40–0.60	0.40–0.70	0.30–0.40
2330	0.27–0.33	0.55–0.90	—	3.25–3.75	—
4130	0.27–0.33	0.55–0.90	0.50–0.80	—	0.20–0.30
4330	0.27–0.33	0.55–0.90	0.50–0.80	1.40–2.00	0.25–0.35

Silicon, 0.40 to 0.60 per cent; phosphorus, 0.50 per cent maximum; sulphur, 0.60 per cent maximum.

Hardenability values of cast steels are similar to those of wrought steels if compositions and grain sizes are similar. Figure 12 indicates good correlation between cast and wrought 2330 steel. Additional comparative data further substantiate the fact that the hardenability factors established for wrought steels can be applied also to corresponding cast steels. Furthermore, the methods and factors applicable to the calculation of hardenability for wrought can be used for cast steels.

It should be pointed out, however, that cast steels may have slightly higher hardenability values than corresponding wrought steels because of their normally higher silicon content and possibly higher manganese content. This is illustrated in Table 5, where cast steel data are compared with AISI data on wrought steels.

Hardenability values for carbon cast steels of austenitic grain size 5 to 9 are presented in Fig. 13. For typical compositions of these steels see Table 6. The curves are representative of values normally expected in the production of the various carbon steel grades. The great majority of carbon steel castings are produced to carbon contents below 0.50 per cent. Hardenability curves for cast steels having carbon contents of 0.50 per cent and over are similar to those of wrought steels. Few hardenability studies have been made on carbon steels of 0.40 per cent carbon and under; hence the curves of Fig. 13 are of exceptional interest.

The hardenability bands illustrated in Figs. 14 to 22, inclusive, were obtained from tests made on cast steels produced by 33 steel foundries. These bands represent values that would normally be expected in the production of low-alloy cast steels of from 5 to 9 austenitic grain size, and should therefore not be used to establish specification rejection limits. The bands prepared by the AISI would be more appropriate for use in establishing such limits.

(To be concluded in the October issue.)

FOUNDRY COKE QUALITY EFFECT ON CUPOLA MELTING

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DEFINITION OF THE TERM "coke quality" depends to a considerable extent on what is demanded of the coke. Coke considered of suitable quality for one operation may not be at all satisfactory for another. Furthermore, the cupola operator may have so adjusted his cupola operation that he gets satisfactory operation with what might be described as a mediocre coke. Under such conditions, it is entirely possible that the substitution of a coke of higher quality might even result in less satisfactory operation for this man. The quality of coke may vary in several ways. Some of these are: (1) coke size, (2) uniformity in size, (3) strength or resistance to breakage, (4) combustion characteristics, and (5) sulphur content. The last-named factor has seldom caused much difficulty.

Although any variations in the properties enumerated in the foregoing may be considered to be a change in coke quality, probably the most-used criterion of coke quality is the effect on the temperature of the iron. Whenever a decrease in iron temperature is experienced, particularly when a new car of coke is received, the coke often receives the blame. Other noticeable effects of a variation in coke quality, or rather a decrease in coke quality, are increased blast pressures and difficulties with bridging in the tuyere zone.

It is sometimes possible to offset a decrease in coke quality, as judged by a drop in iron temperature, by increasing the size of the coke charges. But if more coke is used, more air with corresponding higher blast pressures is needed to maintain the same melting rate. Many blowers lack the reserve capacity to produce the higher pressures and, in such cases, iron temperature and melting rate may both drop.

Coke Properties

The objective of this discussion is not to set up standards for coke quality or to consider the various factors that may affect the quality of coke. Such a consideration is the subject of a previous paper, "Foundry Coke Characteristics and Quality Factors," published in July, 1947 issue of AMERICAN FOUNDRYMAN. The prime purpose of this discussion is to indicate to the cupola operator what he might expect in his cupola operation with a change in coke quality and, also, what he might do in order to get the best out of the coke available.

Although there is no intention of discussing the various properties of coke in detail, it is, nevertheless, desirable to enumerate some of the properties of coke and how they affect its performance in the cupola. The size of the coke is quite important, not only from the standpoint of maximum size but, also, uniformity of size. Since coke must withstand fairly rough handling and also must support the weight of charges in the cupola, the strength of the coke is an important property.

A smaller coke of good strength may give more satisfactory operation than a large coke which is weak. With a small strong coke, cupola conditions can be set up to give optimum results for coke of that size. In the case of the weak coke, a change in coke size will occur in handling and it will be difficult to set up proper conditions. Another property of coke is its combustibility or reactivity. Although these are not the same thing, they are closely related. In one sense, combustibility is the rate of burning for a given rate of oxygen supply. Reactivity is the rate of reaction between the coke and CO_2. One factor related to combustibility, the ignition temperature, affects the combustion of the coke.

Handling of Coke

A coke with a low ignition temperature is likely to give high "solution" losses in the preheating zone of the cupola. As to the ignition temperature of coke, this is fairly closely related to the volatile matter content. Since this is the case, coke producers usually keep quite close control over the volatile matter content of the coke. The fixed carbon content of the coke also has some effect on its combustibility as well as its rate of solution in the iron. In general, a high fixed-carbon coke will tend to produce hotter and higher carbon irons than a low fixed-carbon coke. This is not a hard-and-fast rule since other factors must be considered. Although comparatively little is said about the fusion point and other properties of the coke ash, it is conceivable that a change in coke source may affect cupola operation through a difference in ash properties.

As a result of general shortage of coke, classification of coke by screening to given sizes has, in many cases, been dispensed with in order to increase the yield. Although the screening of coke at the coke plant is not

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an exceptionally rough treatment, it subjects the coke to sufficient tumbling action to stabilize its size. Too often, the handling of the coke by the foundrymen is considerably more drastic than that employed by the coke producer and, as a result, a coke of satisfactory size at the time it left the coke plant may have been so badly treated in subsequent handling that it is considered unsatisfactory at the time it reaches the cupola. Coke is an inherently brittle material and cannot be made stronger without affecting some of its other properties.

Coal Quality Lower

Although the coke producer exercises considerable care in the production of the coke and the running of his ovens, he is, nevertheless, dependent on the quality of the coal supplied to him. Since it is well known that stock piles of coal are at a very low point and that the quality of coal has decreased generally, the coke producer is somewhat limited as to what he can do with regard to coke strength. The cupola operator often can improve his operations considerably through better handling of coke.

There are three places in the handling of coke at the foundry where breakage can be reduced. These are in the unloading of cars, in the handling of the coke from the stock pile to the point at which it is weighed, and in the charging operation. As to unloading coke, the use of a clamshell bucket is highly unsatisfactory. Similarly, the dropping of coke from a self-dumping bucket or a box from a substantial height onto either a concrete platform or onto the bottom of a steel bin subjects the coke to unnecessary breakage. All unloading and handling operations should be conducted in such a manner that the coke is subjected to the least amount of shattering or crushing.

Considerable damage to coke often occurs through improper charging methods. If coke is unnecessarily broken up in unloading, the coke pile will contain rather small coke and large coke. If coke from this pile is randomly selected, it is quite likely that successive charges of coke will be nonuniform as to size. One charge may be made up of quite large coke, whereas the ensuing charge might be made of the small under-sized coke. In mechanical charging methods, it has been found generally that better results are obtained if the coke is charged on top of the bucket rather than on the bottom.

Some types of charging buckets are easier on coke than others. In charging with a drop-bottom bucket, breakage of coke can be minimized considerably by keeping the cupola full. If the cupola is operating with the top of the charges six feet or more below the bottom of the bucket, an undue amount of coke breakage will result. A decrease in coke quality due to lower strength may be offset by more careful handling in the plant.

Coke Quality—Relation to Cupola Melting

Although coke quality is certainly one factor in cupola operation, every case of unsatisfactory operation cannot be always attributed to poor coke quality. Since the results obtained with a given coke depend a great deal on the way in which it is used, some time will be devoted to a discussion of cupola operations and how variations in operation will affect the results obtained from the coke. The results reported and conclusions reached during discussions of this type would be of considerably greater value to the cupola operator if cupola operations were under much better control than they are at present.

Too often, the cupola is the most neglected piece of equipment in the foundry. This is a highly regrettable state of affairs since the quality of the casting leaving the foundry is very much dependent on the quality of the metal leaving the cupola spout. Foundrymen often spend comparatively large sums of money on molding equipment, but object strenuously to spending even a small amount on proper maintenance of a rather remarkable melting unit such as the cupola. It is only because of the remarkable nature of the cupola that satisfactory or reasonably passable operation is obtained with such gross neglect.

It might be a surprise to many foundrymen to learn what they could get out of a cupola if it were operated as carefully as an electric furnace. The cupola has been proven to be one of the most economical types of melting furnaces available. Not only is it remarkable with reference to operating cost, but with proper control, it can be depended upon to supply iron of guaranteed physical properties.

Another factor which is often neglected or lost sight of is the fact that the coke not only supplies heat to melt and superheat the iron but the coke also acts as a refractory material to support the charges in the proper position for correct melting. Better results from a given quality of coke are invariably obtained by better control over the cupola operation.

Controlled Charging

A cupola and its operation are usually neglected in one or two ways; (1) as to maintenance of the cupola as a mechanical unit and (2) as to the proper weighing or measuring of the materials going into the cupola operation. Such materials not only include the iron charge but also the coke, stone, and the air charges.

If consistently good results are desired, it is highly important that all materials going into the operation be carefully controlled. Not only is the weight of the materials important but, also, the size of the materials, particularly with reference to scrap. Uniformly good operation cannot be obtained by using small pieces of material on some charges and heavy pieces on others. The rate at which the pieces melt depends on their melting point and their mass or weight, with other factors constant.

The extent to which the various factors in cupola operation, cupola construction, and cupola equipment affect the results obtained from a given quality of coke will be discussed. For the sake of simplicity, a cupola can be divided into five zones; namely, the preheating zone, the melting zone, the superheating zone, the tuyere zone, and the well. The effect of changes in coke quality on its behavior in the various zones of the cupola varies to some extent since some properties are more important in some zones than in others.

One of the materials entering into cupola operation not always fully appreciated by the foundryman is the air. When it is considered that as much air by weight

is being used as iron is melted, the importance of this material should be apparent. Unless the foundryman has some control over the rate at which air is supplied to the cupola, he is at a disadvantage in getting the best results from the other materials in the charge.

Cupola and Equipment

There is no cupola operation too small not to warrant the installation of a blast-pressure gauge and a blast-rate indicating device. For larger operations, only a controlling air-weight device should be considered, preferably a recording type. The larger operation should also use a recording pressure gauge. Neither the installation of an air-weight control nor a recording blast-pressure gauge will guarantee good cupola performance, but they will help in enabling the operator to reproduce the conditions found to give most satisfactory practice.

The various air-weight control devices now sold for use on the cupola automatically compensate for changes in the density of the air and, therefore, supply a predetermined weight of air, whether it is indicated as cubic feet or pounds. A blast-pressure gauge is a useful instrument for indicating the conditions within the cupola. Fluctuations in windbox pressure with a constant rate of air supply are an indication that melting conditions are varying within the cupola. To allow such irregularities to persist day after day is an indication that the advantages of a pressure gauge are not appreciated by the cupola operator.

A change in pressure may indicate a change in bed height or such other irregularities as bridging and incorrect charging practice. Quite often, full advantage of air-control devices is not obtained because of incorrect installation or numerous leaks in the blast pipe and windbox system. Every effort should be made to keep the blast pipe and windbox system free of air leaks. Quite often an allowance of 5 to 10 per cent is made for air leakage. Such a condition should not be tolerated as it is entirely unnecessary.

With comparatively little effort, a blast pipe and windbox can be kept entirely free of leaks. Tuyere covers should be removed at regular intervals and resurfaced to prevent leakage at this point. However, it is not enough merely to stop air leakage in the blast pipe and windbox system. It is important that tuyeres be made to fit tightly against the cupola shell to prevent air from passing between the tuyere and the shell. As a result of various A.F.A. activities, there is a gratifying trend on the part of foundrymen toward greater appreciation of the importance of air measurement.

Air Distribution Important

With regard to distributing the air within the cupola, some operators attach too much significance to the design of the tuyeres and the tuyere ratio. Quite often, an otherwise good cupola installation will not give optimum results because of poor distribution of air around the cupola. In order to obtain maximum iron temperature and uniform results in the cupola, it is essential that air be equally distributed among the tuyeres. A cupola in which one side is supplied with more air than the other will melt unevenly and produce iron of unpredictable properties. Not only will the iron properties suffer, but it will be necessary to use more coke in order to keep the lowest part of the bed above the minimum desired level. This means too high a bed on the other side of the cupola.

As to tuyere design, some operators prefer continuous tuyeres, others, intermittent tuyeres. Either type works under proper conditions. Tuyere ratios will vary from 2:1 to 8:1 and even as high as 12:1. The distribution of the air in the cupola and the path followed by the ascending gases depend to a great extent on the distribution of materials and size of the voids in the stack of the cupola rather than on such factors as tuyere area or tuyere design. Air and gases in the cupola follow the path of least resistance, and comparatively little can be done about this path by adjustments or alterations of tuyere design.

One factor in cupola design that has a profound effect on the results obtained from the coke is the distance from the top of the tuyeres to the top of the charges or stock height. This distance may vary from as little as 9 ft to an extreme of 22 ft. Cupolas having stock heights of less than 12 ft require very careful supervision of the charging operation in order to get reasonably satisfactory results.

Cupolas with short stacks can seldom be operated at melting rates as high as those obtained with cupolas of the same diameter but with greater stock height. Not only is the height of the charges important but, also, that they be kept at a uniform height throughout the operation. An often-observed practice of allowing the top of the charges to drop five or six feet in the cupola and then bringing the charges up to normal level results in irregularities in iron temperatures as well as melting rate.

For normal operation, stack heights or rather stock heights in excess of 18 ft seem unnecessary since a higher blast pressure is required to force the air through the cupola. With unnecessarily high stacks, solution losses with coke of high reactivity may become rather high. The higher stacks are required when high melting rates are desired or if special types of cupolas such as the balanced-blast cupola are used.

Charging Equipment and Practice

Frequently, poor operation has been blamed on the coke, whereas it should have been placed on poor charging practice. Charging equipment and practice which tends to give unequal distribution of materials in the cupola cannot help but result in uneconomical operation. In coke of very high quality, it is sometimes possible to obtain acceptable results under these conditions.

However, with a decrease in the coke quality, the effect of poor charging practice is quite evident. This not only refers to lopsided charging, that is, charges being higher on one side of the cupola than the other, but also to segregation of the charge material as to size. A system which consistently charges fine materials in one part of the cupola and coarse materials in another contributes to nonuniform gas flow in the preheating zone and uneven bed height.

Some charging systems have a tendency to create high charge density in the center of the cupola and leave the charges at the periphery rather open, thereby allowing most of the ascending gases to travel up along the lining.

Such a condition is conducive to poor coke economy, low melting rate, and cold iron. Some types of charging buckets are harder on the coke, thereby decreasing the effectiveness of the coke.

Improper selection of charge materials as to size will result in nonuniform flow of gases in the preheating zone, with the result that some of the metal pieces will be insufficiently preheated when they reach the melting zone, whereas others will be melted above the zone.

Unless some skill is exercised in their manipulation, the use of wheelbarrows for charging cupolas is not always satisfactory. Similarly, other charging devices which introduce the materials by means of a chute from one side of the cupola are apt to cause considerable segregration of the materials in the cupola. In small cupolas, however, it is possible to obtain reasonably good results with such equipment if ample precautionary means are taken.

Lining in the Combustion Zone

Unsatisfactory results attributed to coke can often be traced to unsatisfactory patching practice in the cupola. When it is realized that more heat is required to form a pound of slag than to melt and superheat a pound of iron, the importance of keeping melting-zone erosion or burn-out to a minimum can be appreciated.

Not only is heat required to melt and flux the refractory burned out, but the increase in volume in the melting zone must be compensated for by adding additional coke. If the melting zone could be maintained to the desired dimensions throughout the heat, considerable savings in coke could be realized in addition to less trouble with bridging and freezing up of tuyeres.

Not only must the materials and the technique used for patching the melting zone be good, it is also necessary that it be properly dried out and preheated before melting actually takes place. Flash heating of the surface of the patch when it is still backed up by wet mud should not be considered satisfactory practice.

Poor patching materials or patching techniques also result in a comparatively large amount of sticky material dropping past the tuyeres and often freezing in front of them. This freezing of material in front of the tuyeres materially affects the distribution of air in the tuyere zone. This material in front of the tuyere often builds up forming a bridge in the tuyere zone. Not only does the quality of the material used in the patching of the melting zone have an effect on the operation but also the dimensions to which the zone is patched.

Lighting-Up Practice

Under some conditions, an improvement in temperature can be realized by decreasing the cross-sectional area of the cupola in the melting zone without changing it above the melting zone. Such a practice will increase the blast concentration, i.e., pounds of air per square foot of cupola area, and thereby extend the melting and superheating zones, providing a greater height of hot coke through which the iron can be superheated.

A poor job of lighting the bed in the cupola will often completely obscure any effect of a change in coke quality. It is highly important that the bed-lighting operation be conducted in such a manner that the well of the cupola is thoroughly preheated before melting starts. Very little combustion takes place in the well zone, and once the coke has dropped into this area, most of the heating of the refractories in the well is through absorption of sensible heat from the coke in that portion.

The method followed in lighting the bed has a profound effect on the drying out and preheating of the refractories in the combustion zone. Sufficient time should be allowed for lighting the bed to ensure establishing equilibrium between the temperature of the surface of the refractories and the rate of heat flow to the shell. It is impossible to establish such a relationship in less than several hours. Although it is desirable to put the blast on the bed for a short time before charging is started to clean it of ash and, also, to cause it to settle down so that the height of the bed can be properly measured, the use of the blast should not be relied upon to offset an otherwise poor light-up operation.

In burning-in the bed, some care must be taken to regulate the air so as not to burn the coke to too small a size. If burning of the bed is prolonged too far or permitted to progress too vigorously, the bed will be filled with small coke rather than with the more desirable larger size which was charged. This small coke will burn rapidly at the beginning of the heat, thereby causing a rather drastic drop in bed height unless precautionary measures are taken. The quality of the bed-lighting operation can be judged by the temperature of the first iron out of the cupola.

Effect of Coke Quality on Operating Conditions in the Five Zones of the Cupola

As pointed out previously, a change in coke quality may affect the operation of the cupola differently in the various zones existing in the cupola. Some properties of coke which might make it very desirable with reference to the performance in the tuyere zone might make it unsuitable to fulfill its proper function in the preheating zone or in one of the other zones.

With reference to the function of coke in the preheating zone, the primary purpose is to support the metal charges and, therefore, resist crushing due to the movement of the stock down the cupola and to the impact resulting from the addition of new charges. A decrease in the size of the coke or in the strength of the coke, thereby resulting in greater crushing and reduction in its size, will result in greater resistance to gas flow through the cupola stack. Higher blast pressures will, therefore, be encountered, with a greater tendency for the gases to pass up along the lining.

Another property of coke which will affect its performance in the preheating zone of the cupola is its ignition temperature and reactivity. A coke with too low an ignition temperature will start to burn through the reaction of carbon dioxide, which produces carbon monoxide in this zone. Should this occur, considerable loss of coke takes place before it reaches the melting zone where it is needed. Since the ignition temperature is related to the volatile matter content, it is desirable to keep the volatile matter contents about one per cent.

The primary function of coke in the melting zone is to supply sufficient heat to melt the iron charges above it. Although many diagrams showing the position of the coke and iron charges in the cupola stack show well-

defined layers of coke and iron, this is seldom the case in actual practice.

Charges become somewhat scrambled in their descent through the cupola so that by the time the melting zone is reached, melting may occur through an appreciable depth. In a well-balanced operation, this melting is restricted to a fairly narrow well-defined zone. Operations not so well under control may have an appreciable extended melting zone. This is not desirable from the standpoint of chemical composition and metallurgical control of the properties of the iron.

If the decrease in coke quality is merely due to a decrease in size, the small coke in the melting zone will result in increased blast pressures and a narrower melting zone. Due to the comparatively large amount of surface exposed when the coke is small, coke combustion may take place at a more rapid rate than desired, thereby necessitating the use of more coke to keep the bed at a safe height. The question of volatile matter content of the coke is very likely wiped out before the coke reaches the melting zone, since the time required to pass through the preheating zone is usually sufficient to drive off the excess volatile matter.

Effect of Ash Content

The ash content of the coke as well as the fusibility of the ash would be expected to have some effect on the performance of the coke in the melting zone. If the ash cannot be fluxed off rapidly, it is possible that the coke in the melting zone will become rather gummed up, causing sudden rises in pressure and a decrease in iron temperature.

Some of the remarks made relative to the performance of coke in the melting zone also apply to the coke in the superheating zone. The superheating zone is that part of the coke bed at the highest temperature. It also corresponds to a zone of complete combustion. In this zone, all oxygen has been eliminated and carbon dioxide content of the gas is at a maximum. This region corresponds to the area of maximum burn-out in the cupola, ordinarily 15 to 18 in. above the tuyeres.

If coke becomes small, this superheating zone will become shallower due to more rapid reaction between the oxygen in the air and the carbon in the coke. Although it is difficult to set up a test designed to indicate the temperatures reached by the combustion of the coke, it is felt that some changes in combustion characteristics of the coke may be reflected in the temperature reached by the coke in this part of the cupola. Cokes of low carbon content are not likely to reach as high temperatures as those of higher carbon contents.

If a coke is of small size in the superheating zone either because of initial small size or due to crushing as a result of low strength, the superheating zone can only be extended by increasing the blast rate. In order to keep coke at maximum temperature in the superheating zone, it is desirable to keep the coke clean by means of sufficient slag, high in lime, to wash off the ash produced in the combustion of coke in this zone. This scavenging action of the high-lime slag in the superheating zone is highly important if maximum temperatures are desired. Conditions in the superheating zone also influence the carbon picked up by the iron.

A difference in coke behavior has often been observed at the tuyere level. Some types of coke seem to turn dark more rapidly than others after the blast is turned on. In this regard, blast temperature has a pronounced effect on the temperature of the coke immediately in front of the tuyeres. Even a mild increase of temperature from 70 to 250 F has a noticeable effect.

Coke Reactivity Factors

From the standpoint of maintaining high temperatures immediately in front of the tuyeres, a highly reactive coke would be desirable. However, as pointed out previously, such a highly reactive coke would be destroyed at a fairly rapid rate in the preheating zone. It would be a nice thing if a highly reactive coke could be safeguarded against solution losses in the preheating zone until it reached the tuyere zone. The temperature of the coke near the tuyeres, in addition to being affected by coke quality and blast temperature, is also affected by melting rate and the amount of slag dropping to the well.

Since combustion of the coke is not complete until the superheating zone is reached, the temperature of the coke at the tuyere level is of necessity lower than that in the superheating zone. The temperature of the coke in the tuyere zone is appreciably increased by the descent of the hot iron and slag from the superheating zone above. It was frequently observed that a cupola exhibiting a considerable amount of iron dropping past the tuyeres will have cleaner tuyeres than one in which the melting takes place farther toward the center of the cupola.

The matter of ash content of the coke is probably important in the tuyere zone. The low-carbon coke is more likely to result in a colder tuyere-zone area than a high-carbon coke. Small coke at the tuyere zone will result in poor penetration and distribution of the air blast. Too small a coke in the tuyere zone is also likely to result in bridging in front of the tuyeres.

The effect of coke quality in the well zone is probably not nearly so pronounced as it is in a tuyere melting and preheating zone. Small coke in the well may cause some difficulty with the slag hole becoming plugged with pieces of coke. A coke of very low reactivity, that is of high ash content, may result in a colder operating slag hole and give some difficulty with free slagging.

Low-carbon cokes are apt to give less carbon absorption in the well than high-carbon cokes. However, since a high-carbon coke is also likely to develop more heat in the superheating zone, it is difficult to determine whether greater carbon pickup resulted from the contact with the coke in the well or with the hotter coke in the superheating zone. A well filled with very small coke will, of course, have less metal capacity than one filled with fairly large coke.

Factors Affecting Iron Temperature

If the various factors which affect the temperature of the iron as it reaches the well in the cupola are classified, it will be found that there are only three primary factors responsible for metal temperature. These are (1) the amount of steel in the charge, (2) the depth of the superheating zone, and (3) the temperature of the superheating zone. Of course, the temperature of the

iron tapped also depends on how long it is held in the well of the cupola and some of the other conditions existing in the cupola well.

Iron temperature depends on the amount of steel in the charge because steel melts at a considerably higher temperature than pig iron or scrap iron. The drops of carburized molten steel start out at an initial temperature approximately 500 degrees higher than drops of molten iron. A drop of molten steel, therefore, does not require as much superheating as a drop of molten iron in order to reach a desired temperature of, say, 2800 F. All other things being equal, hotter iron should be expected when the amount of steel in the charge is increased.

Superheating Zone Depth

The depth of the superheating zone, of course, affects iron temperature, since too short a zone will not allow the drops of iron descending through this zone to absorb the heat available. Coke size, reactivity, coke ratio, and blast rate affect the depth of this zone. The temperature of the superheating zone in turn is affected by melting rate, coke quality, blast rate, and blast temperature. It is also quite likely that the amount of slag falling through the superheating zone affects its temperature, since it cleanses the coke and exposes fresh carbon to the oxygen entering the combustion zone.

Although the three primary causes enumerated above can be held responsible for iron temperature, there are a number of factors which contribute to the three causes and make the relations more complicated. The remarks above also indicate that certain changes in coke quality or cupola operation affect not only the depth of the superheating zone, but the temperature as well. Most often, the two factors cannot be varied separately.

In analyzing operations of cupolas in a number of foundries and comparing the results obtained, it was found that there was a fairly good relationship between the rate of combustion of coke per square foot of cupola area and the temperature of the iron obtained. The relation was somewhat independent of coke ratio.

Analysis of the operations of cupolas that produce hot iron indicates that the air to coke ratio is on the order of approximately 8 to 9 lb of air per lb of coke. With such an operation, the carbon dioxide content of the stack gas falls within the range of 12 to 14 per cent. Excessive air to coke ratios indicate that an attempt is made to drive the cupola at a rate faster than iron can be melted.

Carbon dioxide contents of the stack gas of less than 12 per cent indicate that too much coke or too little air is being used. On the other hand, a trend in carbon dioxide content in excess of 14 per cent often indicates that the bed is burning too low as a result of insufficient coke or too much air. With reference to cupola efficiency, it is desirable to use a minimum amount of air to a given weight of iron melted.

Coke Quality Variation—Metallurgical Effects

Since coke quality affects cupola operation in several ways, it often becomes rather difficult to determine whether a change in the metallurgical properties of the iron is a result of differences in coke quality or of a change in cupola melting conditions resulting from a change in coke. The matter of carbon pickup is, of course, dependent not only on coke quality but also on other melting conditions within the cupola.

It has been definitely proven, however, that higher carbon cokes, pitch coke being an example, will result in a greater carbon pickup in the cupola. Similarly, low-carbon cokes will produce lower carbon irons. It is also entirely probable that the amount of inoculation needed to correct undesirable structures in iron may be related to some property of coke. It is known that iron held in the well of a cupola will often show a decrease in chill, particularly if it is hot and the coke is of good quality. It is a fairly well-known fact that if the iron runs cold because of a decrease in coke quality or a change in melting conditions in the cupola, which in turn were caused by a change in coke quality, the iron will show an increase in the amount of undesirable graphite structure.

It may also be possible to attribute an increase in chilling tendency of the iron to lower coke quality, the composition being the same. Some cupola operators have observed or rather attributed unsoundness of iron and defects such as interdendritic shrinkage to high volatile matter in the coke. This is somewhat open to criticism since it is likely that the volatile matter will be driven out before it reaches the melting zone.

Summary

A considerable improvement in coke economy may be effected by paying careful attention to the construction and maintenance of the cupola and the operation of the auxiliary devices. Cupolas having stack heights of less than 12 ft should be rebuilt or altered in order to increase the height to at least 14 ft, and preferably more. All air leaks should be eliminated and air-weight and air-pressure control instruments installed if they are not on the cupola at the present time. Improved operation will result if more attention is given to supervision of the charging operation. Undesirable melting conditions in the cupola caused by poor charging will result in cold iron at the spout. However, by the time the cold iron is observed at the spout, it is too late to correct the poor charging responsible for the condition.

Proper lighting of the bed is important for short heats as well as long heats. It has been found difficult to correct conditions caused by poor bed-lighting practice later in the heat.

If melting conditions in the cupola are correct as to bed height, air to coke ratio, and coke to iron ratio, it is entirely possible that a good quality of iron can be produced at temperatures below 2750 F. In such an event, it is highly important that the loss in temperature of the iron after it leaves the cupola is kept to a minimum.

Althouh the fluidity of the iron or its ability to fill a mold depends on the composition, superheat is one of the most important factors. Therefore, with lower spout temperatures, it is highly important to decrease the temperature losses during handling so that the iron reaches the mold at a safe temperature. There is hardly any cupola operation that cannot be improved in some respect with reference to obtaining more uniform iron temperature, higher iron temperatures, and the use of less coke.

UNIVERSITIES TO AWARD EDUCATIONAL SCHOLARSHIPS

BEGINNING WITH the 1947-48 collegiate year, scholarships will be awarded by each of the five universities in which the Foundry Educational Foundation program is being maintained.

Cooperating are University of Wisconsin, Cornell University, Massachusetts Institute of Technology, University of Cincinnati and Case Institute of Technology. This year between 45 and 50 students will receive Foundation scholarships. The number of students on Foundation scholarships will increase in the Fall of 1948 to 85 or 90, and in 1949, to more than 120. By 1950, 140 scholarships will be in effect.

Some graduates are expected in the Spring of 1948. After the third year, 40 to 50 graduates from the scholarship program will annually be candidates for foundry industry careers. Additional graduates who voluntarily elect the courses are also expected to be available.

Young men seeking a career in the foundry should bear in mind that the needs of the industry are very heavy in the supervisory fields. The Foundation plan will ultimately furnish men who can be promoted through the lower supervisory and technical levels into the numerous other managerial functions of foundry operation, such as personnel managers, purchasing engineers, cost control, technical salesmen, for positions in the various engineering fields such as plant, industrial and product, and ultimately up to department and plant managers. The courses initially arranged by the five universities have been developed with this in mind. Some adjustment in the college programs will be made from time to time as experience establishes the need.

Industry Needs Men

These courses are open to anyone. The Foundation scholarships will be recognition of excellence and financial need on the part of the individual students. All interested men, however, may take the courses offered, as the need for trained candidates to become the engineering management of the industry is growing with the years. Over 500 Foundation member companies have acknowledged the need for trained men by their contributions to the scholarship fund.

The scholarships are available to upperclassmen at Case Institute of Technology, University of Cincinnati, Massachusetts Institute of Technology, University of Wisconsin, and to all classes at Cornell University. Like other schools, the five universities in this program are crowded. High school students are urged to apply for entrance to the university of their choice, at the end of their Junior year being sure to mention their interest in the Foundry Educational Foundation program, and the foundry electives being offered by the university. Second and third choices should be in reserve in the event of disappointment at the first try.

Universities Aiding

Crowded conditions in some of the Foundation colleges permit only one in ten to be admitted. Each of the five universities, however, is engaged in expansion programs which will increase the number of entrants in the various departments. Each of the universities is cooperating to the utmost in providing more adequate training and more engineering graduates for the foundry industry, one of the largest industries in this nation.

Students seeking admission as Freshmen are all required to meet the standards of the university of their choice. Interest in the foundry training program does not exempt an applicant from this requirement.

Transfer students will be treated as individual problems. Exceptional transfer students may be eligible for scholarships depending on the policy of the university in question.

Policies

Applicants for, and recipients of scholarships at the cooperating universities will be governed by the following policies:

1—*The Student must meet the requirements of his University as to method of selection for the scholarships.*

This method of selection will vary from one university to the next, but in most cases selection will be by a committee composed of professors in the engineering college.

2—*The student is to select foundry subjects and supplementary work as outlined by his advisor.*

Basic engineering courses have been modified and supplemented with courses from other departments, to create what is known as the "Foundry Option."

3—*Acceptance of this scholarship carries with it the obligation to work in a foundry selected or approved by the Foundation for at least one summer, except by specific arrangements. In the event of need, the Foundation will be responsible for locating the student in a suitable plant. Students are urged to avail themselves of additional summers in the foundry and will find the Foundation cooperative in this regard.*

The Foundation believes that first hand experience with foundry problems will develop an appreciation within the student for the studies in his course, as well as to reveal the present-day methods which can be improved, changed or eliminated in favor of more modern ways by foundry engineers.

4—*The student is to write his thesis or problem, if required by*

(Concluded on Page 79)

Northwestern Active in Foundation

Northwestern University Institute of Technology, Evanston, Ill., has become a cooperative member of the Foundry Educational Foundation. Dr. O. W. Eschbach, dean of the school, recently notified Foundation Executive Secretary George Dreher of the school's willingness to participate in the foundry educational program.

The use of the spectrograph in the production of copper base foundry ingot is described. Among the applications discussed are the control of furnace production, the analysis of scrap and stock materials, the sorting of metals, the analysis of samples from outside sources as a customer service, and the use as a qualitative aid to the chemical department. Among the elements determined spectrographically are tin, lead, zinc, iron, nickel, antimony, aluminum, manganese, silicon, magnesium, beryllium, arsenic, and chromium. A description of the apparatus and sampling method used and the manner of preparing standard samples are included. Curves are given to show the relationship between conditions in the analytical gap and the length of preburn time. The analytical procedure is described and results are given for several of the alloy types run under routine conditions. A study of the data obtained on the 85-5-5-5 alloy shows that the accuracy expected is 3 per cent for the elements iron, nickel and antimony.

SPECTROGRAPHIC ANALYSIS

Brass and Bronze Ingot Production

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and
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H. Kramer & Co.
Chicago

APPLICATION OF THE SPECTROGRAPH to foundry control analysis is well recognized in the ferrous and light metal industries and has been reported on previously in the TRANSACTIONS of the American Foundrymen's Association.[1, 2] Its application to the copper base and particularly the red metal alloys has not been as extensive probably for two reasons.

The first is the large number of different copper base alloys which are made today. Since the nature of the method of analysis is a comparative one, in that an unknown sample is measured in terms of a standard similar sample, the problem of preparing these standards and analytical curves becomes enormous.

The other reason is that the range of concentrations of the alloying constituents in copper base alloys may run from a mere trace to 40 per cent. Where the accuracy expected by the usual spectrographic methods of analysis would be acceptable for concentrations below two per cent, this accuracy is insufficient for control work at the higher ranges encountered in most of the alloys used for brasses and bronzes.

Another factor that has been found to influence the accuracy of results is the apparent effect that a slight variation in one of the major constituents has on the overall analysis. This type of influence has been found to be true in other than copper base alloys.[3, 4]

Spectrographic Methods Developed

Some workers [3, 4] have developed systems of corrections to extend the useful range of the analytical curves, thus reducing the number of standards required. Others have applied the solution method [5, 6] to the analysis of higher concentrations or have used specially designed [7] controlled source units for greater accuracy.

It is not the purpose of this paper to make a critical study of a particular method of analysis but rather to show how the spectrograph has been successfully applied to the manufacture of brass and bronze ingot supplied to the foundry trade. An outline of the method of analysis used and the results of investigations of some variables involved are included. Results as obtained by the analytical procedure are given for several of the alloy types run by different operators.

At the present time six applications can be mentioned where the spectrograph is used either quantitatively or qualitatively to reduce the time required for the release of results or to make a greater number of analyses than was possible by chemical methods alone.

1. First in importance is the control of large reverberatory furnaces used in the smelting and refining processes. These furnaces have a capacity of about 120,000 lb per charge. As soon as the metal is molten, samples are taken at frequent intervals, in order to follow the progress of refining and to control additions of alloying metals to the furnace.

Rapid Analysis Promotes Control

A number of elements may be run on a single sample. Those most commonly determined in non-ferrous foundry alloys are tin, lead, zinc, iron, nickel, antimony, aluminum, silicon, manganese, arsenic, beryllium, magnesium, and chromium. Speed and accuracy are essential and results must be reliable and representative of the entire charge in the furnace.

The average time consumed in making quantitative determinations on six elements by spectrographic procedure usually is about 15 min. A corresponding

Table 1.—Distribution of Alloying Elements in Spectrographic Samples
(Chemical Analysis)

	Cu	Sn	Pb
Iron Mold Pin Tip	85.46	4.85	4.90
Iron Mold Pin Bottom	85.51	4.81	4.91
Iron Mold Head Drillings	85.60	4.77	4.89
Glass Tube Pin Tip	85.28	4.85	4.95
Glass Tube Pin Middle	85.26	4.86	4.99
Glass Tube Pin Bottom	85.23	4.83	4.94

chemical analysis would take an hour or more. The saving in time thus realized makes possible closer control on many elements contained in the various alloys.

Two important elements which are controlled almost exclusively by spectrographic methods in our copper-tin-lead bearing alloys are zinc and iron. The analysis of zinc particularly is a long and difficult procedure by wet chemical methods, and there are many alloys in which zinc must be kept below a certain maximum value. Spectrographic analysis of these alloys has resulted in a considerable saving both in operating costs and in the reduction of losses by oxidation of other metals such as tin and lead.

In this type of control work, furnace drift may be considerable for some elements as the refining processes proceed. For example, in making an 80-10-10 copper-tin-lead alloy, the first sample taken from the furnace may show from 2-3 per cent zinc, which must be reduced by refining usually to a 0.75 per cent maximum value. In this case, the analytical procedure is varied depending on the zinc content in order to secure the correct result. Several analytical line pairs may be used to cover a long range of concentration or if a number of suitable line pairs are not available, a filter is used to reduce the intensity of the useful ones.

Check Small Batch Production

2. The second use is in checking small furnace and pot production for minor elements and for the presence of unwanted impurities. Some alloys such as the high strength manganese bronze, aluminum bronze and hardeners are made in smaller heats depending upon the composition of the alloy and the requirements of the customer. A number of heats may be made of a single alloy in this manner. Each is analyzed spectrographically and the average results compared with the chemical analysis made on a composite in which each heat is equally represented. Heats that may be outside of specification limits or that might contain some impurity that would be injurious to the alloy or to its application can readily be identified, and adjusted in this manner.

It would be economically impractical for the chemical laboratory to run these heats individually and here the spectrograph has found an important application because of its speed and ability to handle a large volume of analysis with a minimum of manpower.

3. All scrap and stock materials including virgin metals are analyzed before they are used in the furnace. The spectrograph is used to determine the minor elements in amounts below 2 per cent, as previously mentioned. The chemical laboratory runs the major constituents—copper, tin and lead. In this way the production manager has a complete analysis of the material going into the furnace.

Sample Form Varies

The sample in this case may be in one of several forms. A piece of tubing, a large casting, or even grindings may be sent in for analysis. The technique employed will have to suit the size and shape of the sample. If at all possible a rod sample is preferred, but provision is made to handle large and odd shaped pieces.

4. The fourth use of the spectrograph is as a qualitative aid to the chemical department in the determination of those elements present in appreciable amounts in a sample to serve as a guide in their analysis. Many times samples are submitted of which little metallurgical history is known. A quick spectrographic analysis saves many hours in looking for elements which may or may not be present. It has also proved valuable in this respect to the research department in many of its investigations.

5. The spectrograph is also used to good advantage in sorting alloys that would be difficult to separate otherwise. For example, some condenser tubes contain about one per cent of either aluminum or tin, and their ultimate separation is highly desirable for their most economical use. It requires only a few minutes to obtain a spectrographic identification and from thence a sorting procedure can be based on accompanying physical characteristics.

6. Samples are frequently submitted by customers for chemical analysis. If the material is in such form that a pin may be machined from the casting, quantitative spectrographic determinations are made for minor elements or impurities. Otherwise semi-quantitative results are obtained which may be sufficient for the particular problem under consideration or may serve as a guide to a wet chemical analysis.

Apparatus Complete

The equipment used consists of a multisource unit, a large Littrow spectrograph, densitometer-comparator unit, calculating boards, an electrode shaper and other accessories. A small bench lathe is used to prepare surfaces on the samples to be sparked or arced. A high frequency induction furnace is available for preparing standard samples.

The darkroom is equipped with a developing machine of the rocking type, with the temperature controlled at 70 F. An electric drier is used to speed the drying of the photographic plates.

Both the spectrographic laboratory and the darkroom are air conditioned with the temperature maintained from 72 to 75 F and the relative humidity at

Table 2.—Uniformity of Glass Tube/Rod
(Spectro-Analysis)

Section No.	1	2	3	4	5	6	7
Nickel, per cent	0.63	0.63	0.65	0.65	0.62	0.68	0.63
Iron, per cent	0.24	0.26	0.25	0.25	0.25	0.25	0.25
Antimony, per cent	0.22	0.21	0.21	0.21	0.22	0.21	0.20

about 50 per cent. Air conditioning of the laboratory is necessary because large variations, particularly in the relative humidity, will cause the sensitivity of the photographic plates to change.

Sampling Method

When the spectrograph was installed, samples were cast in a split iron mold. Considerable difficulty was experienced in filling the mold completely and in securing good spectrographic pins. It was finally abandoned in favor of the pyrex glass tube now used in all our work. In this method metal is sucked up a pyrex glass tube to form a rod 1/4 in. in diameter and 5 to 15 in. long. It was adapted as best suited to our needs for the following reasons:

1. The rods are representative of metal in large heats.
2. They give reproducible results.
3. Operation is simple.
4. Contamination from previous heats is eliminated.

Sample Uniformity Checked

Numerous tests were made to determine the uniformity of the chill cast specimen and also whether the sample taken in this manner would represent the furnace charge. Chemical analysis made on sections near the tip, middle and bottom of the pin were compared with the routine method of ingot sampling for chemical analysis. Table 1 shows some of the results.

Chemical analyses for the minor elements—iron, nickel and antimony—indicate that these elements are uniformly distributed throughout the entire casting.

Table 2 shows the results of spectrographic analyses made on a sample taken in a glass tubing and sparked in 1/4 in. section along its entire length.

A number of investigators have claimed that the accuracy and reproducibility of spectrographic analyses are influenced by the grain size of the metal or alloy. Our experience indicates that pins taken from the same batch of metal in rapid succession by the glass tube method, where some are air cooled and others immediately quenched in water, show no noticeable difference in the accuracy or reproducibility of analysis.

The effect of pouring temperature on sampling was also investigated. A charge of 85-5-5-5 alloy was heated in a high frequency induction furnace to 2175 F. The metal was then allowed to cool as samples were taken in a glass tube at regular intervals. Results are shown in Table 3 and pouring temperature apparently has little effect on the composition of samples taken by the glass tube method.

Pin Size Established

Sample pins of various sizes have been tried ranging from 1/8 in. to 1/2 in. in diameter. Little difference is

Table 3.—Effect of Pouring Temperature
(Spectro-Analysis)

Temperature, °F.	2175	2100	2050	2000	1950	1900	1875
Tin, per cent	5.25	5.35	5.30	5.25	5.15	5.10	5.20
Lead, per cent	5.10	5.00	5.10	5.05	4.95	4.85	5.05
Zinc, per cent	3.95	3.95	3.85	3.70	3.75	3.60	3.50
Nickel, per cent	0.76	0.75	0.76	0.77	0.76	0.76	0.77

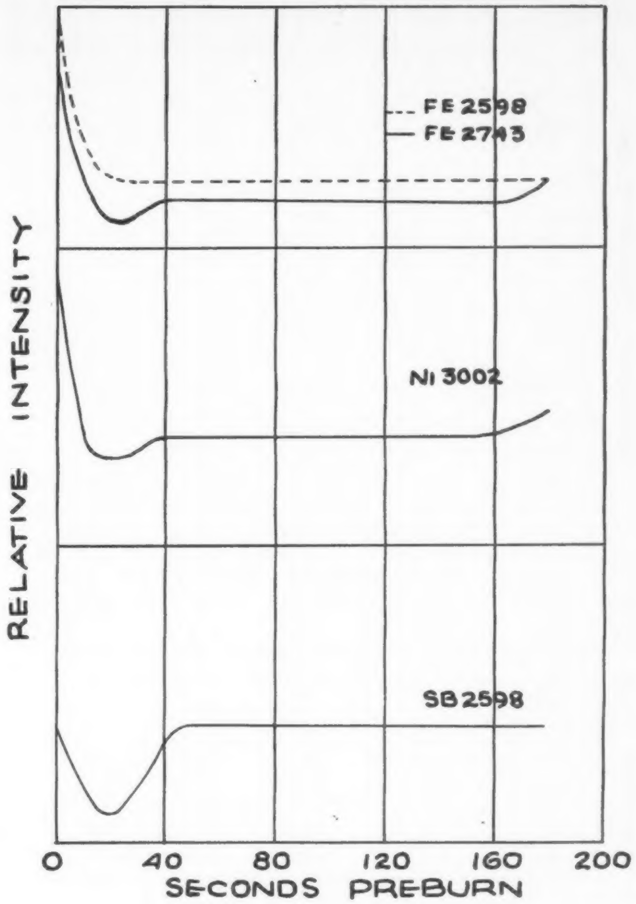


Fig. 1—Preburn curves.

noticed in analytical results. However, if the pin is too small the spark tends to jump around the prepared surface and strike along the side of the pin or the pin may become excessively heated and give erroneous results. It is difficult to take samples in the foundry if the size of the glass tubing is greater than 1/4 in. inside diameter.

From the above results and other similar tests, it was concluded that the samples as taken in the glass tubing were uniform in composition and representative of the charge. This method is used for all foundry work and has proved very satisfactory.

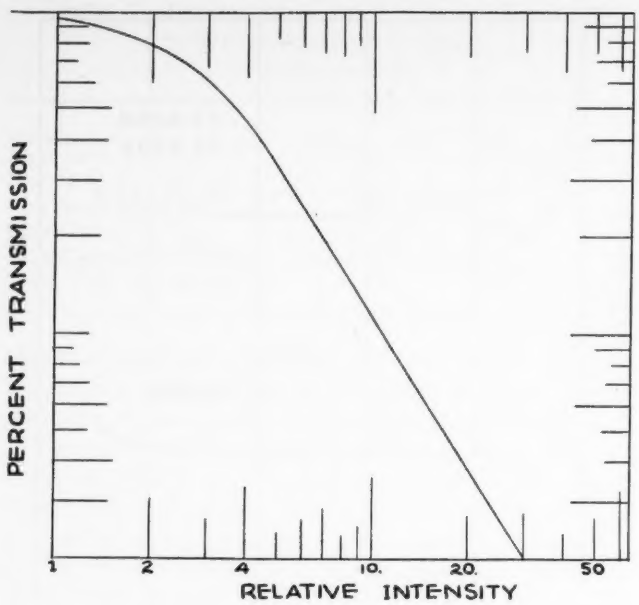
Preparation of Standards

Virgin metals are used in preparing standard samples and are melted in a high frequency furnace. These heats are remelted at least three times in order to secure uniform alloying of the various constituents.

In the preparation of standards to cover a particular range of concentrations two heats are made, one containing the maximum and the other the minimum amounts of the constituents to be determined. By proper mixing of these two heats the intermediate values are easily obtained.

Spectrographic samples are taken by pyrex glass tubes as previously mentioned. These samples are analyzed by the chemical laboratory using the best approved methods.

The section of the pin used for analytical work is the end furthest from the molten metal as the sample is taken in the foundry. The end immersed in the



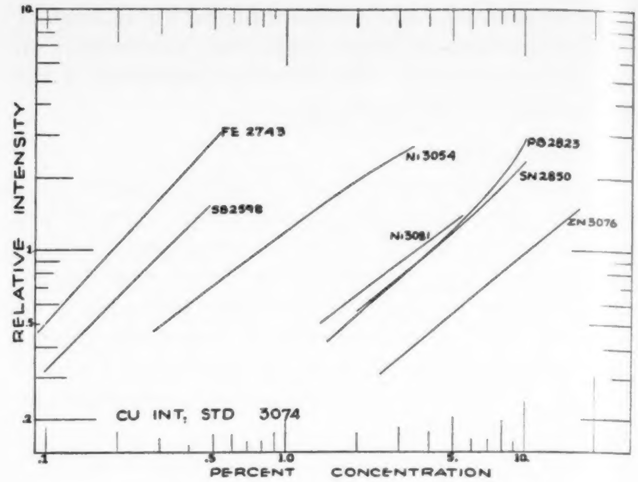


Fig. 2, left—Plate calibration curve.
Fig. 3, above—Analytical curves for 85-5-5-5 alloy.

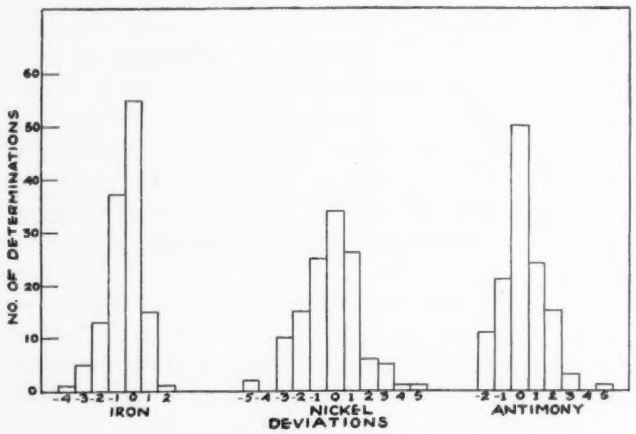


Fig. 4—Precision of iron, nickel, antimony determinations expressed in hundredths of a per cent deviation from chemical analysis. Average deviation, 4%.

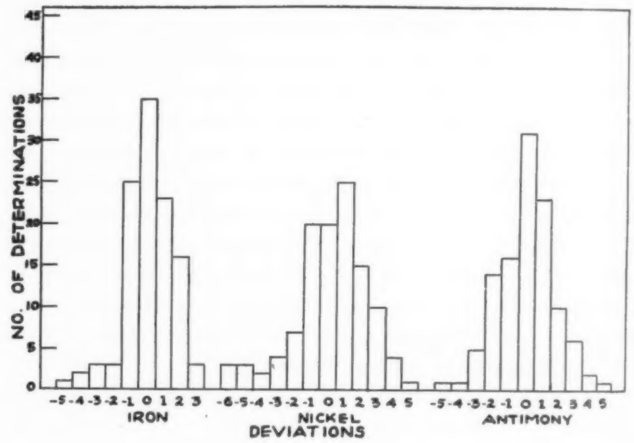


Fig. 5—Accuracy of iron, nickel, antimony determinations expressed in hundredths of a per cent deviation from chemical analysis. Average deviation, 3%.

TABLE 4.—OPERATING CONDITIONS

Source	A Spark	B Arc
Capacitance	2 Mf.	50 Mf.
Inductance	50 Mh.	480 Mh.
Resistance	Residual	40 Ohms
Upper Electrode	¼ in. Pins Machined Flat	¼ in. Pin—120°
Lower Electrode	¼ in. Graphite 120°	¼ in. Pin—120°
Preburn Time	30 Sec.	15 Sec.
Exposure	60 Sec.	5 Sec.
Spectrograph	Set for Region	2580-3580 A
Slit Width	35 Microns	35 Microns
Cap Width	3 mm.	3 mm.
Distance Source to Slit	60 cm.	60 cm.
Plates	S.A. No. 1	S.A. No. 1
	Development, D 19	3 min.
	5% Acetic Acid Solution	½ min.
	X-Ray Fixer	1 min.
	Wash	1 min.
	Dry	2 min.
	Total Processing Time	7½ min.

TABLE 5.—LINE PAIRS FOR RED BRASS ALLOYS

Int. Std. Line	Element Line	Range	Remarks
Cu 3074	Sn 2850	2.5 – 7.0	
Cu 3074	Pb 2823	2.5 – 7.0	
Cu 3074	Zn 3076	2.5 –10.0	Iron Interference [1]
Cu 3074	Fe 2743	0.08 – 0.50	
Cu 3074	Fe 2966	0.50 – 1.00	
Cu 3074	Ni 3051	0.10 – 0.50	
Cu 3074	Ni 3054	0.50 – 1.00	
Cu 3074	Sb 2598	0.08 – 0.80	Fe Interference [2]
Cu 3074	Si 2881	0.005– 0.05	
Cu 3074	Al 3092	0.005– 0.05	
Cu 3290	Zn 3303	2.0 –10.0	Used in Conjunction with Screen Filter [3]

[1] Fe Line at 3075.73 not resolved with a slit width of 35 microns.

[2] Fe Line at 2598.38 very sensitive and intense. Forms background when Fe greater than 0.20 per cent.

[3] To cut down intensity of Zn 3303 Line at concentration greater than 1.0 per cent, screen filter used at source.

TABLE 6.—REPRODUCIBILITY TESTS ON 85-5-5-5 ALLOY

Date	Iron, percent	Nickel, per cent	Antimony, per cent
10-24-44	0.15	0.49	0.18
10-26-44	0.15	0.49	0.19
10-28-44	0.16	0.50	0.17
10-31-44	0.15	0.50	0.17
11- 1-44	0.16	0.50	0.19
11- 3-44	0.16	0.50	0.19
11- 4-44	0.16	0.50	0.19
11- 7-44	0.16	0.48	0.18
11- 8-44	0.16	0.50	0.18
11-13-44	0.16	0.51	0.19
11-16-44	0.16	0.50	0.19
11-18-44	0.16	0.49	0.19
11-22-44	0.18	0.50	0.18
12- 7-44	0.16	0.48	0.16
12-15-44	0.16	0.50	0.18
12-23-44	0.16	0.51	0.18
1- 4-45	0.15	0.49	0.18
1- 8-45	0.15	0.48	0.17
Average Spectrographic Analysis	0.16	0.50	0.18
Original Chemical Analysis	0.16	0.50	0.16

TABLE 7.—REPRODUCIBILITY TEST FOR 80-10-10 ALLOY

Date	Fe, per cent	Ni, per cent	Sb, per cent	Zn, per cent
9-30-44	0.028	0.27	0.26	0.55
10-13-44	0.035	0.27	0.26	0.55
10-16-44	0.035	0.28	0.26	0.56
10-24-44	0.028	0.27	0.25	0.53
10-26-44	0.025	0.28	0.26	0.56
10-28-44	0.028	0.28	0.23	0.53
10-41-44	0.025	0.27	0.21	0.54
11- 1-44	0.027	0.28	0.24	0.54
11- 2-44	0.025	0.27	0.21	0.55
11- 3-44	0.023	0.27	0.22	0.56
11- 4-44	0.025	0.27	0.23	0.55
11- 7-44	0.027	0.27	0.23	0.53
11- 9-44	0.026	0.29	0.25	0.55
11-14-44	0.028	0.29	0.25	0.52
11-17-44	0.025	0.28	0.25	0.54
11-21-44	0.030	0.30	0.28	0.53
1- 1-45	——	0.27	0.27	0.53
Average Spectrographic Analysis	0.028	0.28	0.25	0.54
Original Chemical Analysis	0.03	0.28	0.26	0.55

metal usually becomes oxidized and deformed because of collapse of the glass tubing at the high temperature.

PREBURN TIME

It would be expected that in an alloy such as the 85-5-5-5, 80-10-10 or similar red brass where there are several constituents with varying melting and boiling points, equilibrium conditions would not be attained immediately in the analytical gap. This was found to be true as shown in Fig. 1.

Minimum Preburn 30 Seconds

In order to determine the minimum time necessary to secure equilibrium conditions for a given alloy, the spark is allowed to run continuously for a period of about 3 min. During this time, a series of exposures is taken with increasing pre-burn intervals. Curves as in Fig. 1 result when the computed relative intensitives of the selected line pairs are plotted as a function of the preburn time. In routine work a minimum of 30 sec. preburn was found necessary for the analysis of the impurities.

ANALYTICAL PROCEDURE

The sample as received in the laboratory is in the form of a pencil ¼ in. in diameter and about 5 in. long. A length of ¼ in. is cut from the upper end of the

TABLE 8.—COMPARATIVE RESULTS FOR 85-5-5-5 ALLOY

	Cu [1]	Sn	Pb	Zn [2]	Fe	Ni	Sb
S.A.	84.65	4.39	5.36	4.70	.19	.60	.16
C.A.	84.71	4.29	5.33	4.69	.20	.63	.15
	85.88	4.35	5.50	4.60	.18	.32	.17
	84.80	4.36	5.49	4.74	.17	.30	.14
	87.70	4.05	3.80	3.60	.28	.43	.14
	87.43	4.29	3.95	3.49		.42	.14
	88.64	4.30	3.70	2.70	.18	.45	.13
	88.62	4.20	3.75	2.67	.18	.45	.13
	86.21	3.90	4.45	4.65	.25	.39	.15
	86.57	3.63	4.39	4.73		.39	.14
	84.66	4.25	4.95	5.40	.17	.40	.17
	84.37	4.39	5.02	5.41	.17	.37	.17
	87.43	4.25	5.05	5.15	.23	.43	.16
	84.54	4.58	5.07	4.91	.22	.43	.15
	84.75	4.30	5.45	4.45	.22	.53	.20
	84.87	4.42	5.52	4.10	.20	.55	.21
	84.59	4.30	4.80	5.50	.23	.48	.10
	84.10	4.44	5.06	5.59	.24	.49	.08
	85.07	4.50	4.48	5.00	.19	.49	.17
	84.90	4.59	4.70	4.89	.18	.18	.16

[1] Spectrographic Analysis, Cu by Difference.
[2] Chemical Analysis, Zn by Difference.

TABLE 9.—COMPARATIVE RESULTS ON 80-10-10 ALLOY

	Fe, per cent	Ni, per cent	Sb, per cent	Zn, per cent
S.A.	0.010	0.12	0.10	0.37
C.A.	0.004	0.12	0.09	0.41
	0.01	0.23	0.11	0.62
	0.027	0.21	0.08	0.56
	0.02	0.28	0.12	0.56
	0.04	0.32	0.09	0.45
	0.02	0.32	0.14	1.10
	0.03	0.32	0.12	1.07
	0.01	0.19	0.13	0.21
	0.02	0.17	0.15	0.18
	0.06	0.45	0.25	1.45
		0.42	0.27	1.46
	0.03	0.28	0.26	0.77
		0.25	0.26	0.70

TABLE 10.—COMPARATIVE RESULTS ON LOW STRENGTH MANGANESE BRONZES

	Sn	Pb	Fe	Al	Mn	Ni
S.A.	0.26	0.25	1.20	1.40	0.36	0.08
C.A.		0.22	1.19	1.14	0.31	0.09
	0.18	0.15	1.07	1.24	0.28	
	0.16	0.17	1.11	1.20	0.27	
	0.90	0.51	0.75	1.25	0.32	0.23
	0.95	0.60	0.78	1.11	0.33	0.30
		0.15	1.30	1.08	0.41	
		0.21	1.24	0.98	0.44	
	0.69	0.72	1.03	0.93	0.18	0.08
	0.69	0.61	1.12	1.20	0.28	0.10
	0.11	0.18	1.25	1.15	0.26	
	0.11	0.15	1.47	1.17	0.34	
	0.28	0.24	0.95	0.96	0.24	
	0.31	0.26	0.94	1.01	0.26	
	0.07	0.07	1.13	1.19	0.23	
	0.10	0.02	1.23	1.14	0.22	
	0.15	0.17	1.17	1.04	0.26	0.05
		0.17	1.21	1.03	0.28	

pin and discarded, and the same cut surface on the remaining piece is machined flat and as smooth as possible. The edges are rounded off slightly. It is then sparked with a counter electrode of special high purity spectroscopic graphite pointed to a 120° cone. It was found that by using a counter electrode of graphite the length of exposure necessary to secure the correct line densities on the photographic plate was considerably less than when two pins of the same material were used. A standard is included on each plate to check the analytical curves.

All samples from foundry production are run in duplicate, the pin being resurfaced on the lathe and a clean graphite rod used as the counter pin. The average of the two results is taken and reported directly to the foundry foreman. Care must be taken at all times that the pin is sound and has no central pipe, a condition which sometimes occurs when samples are not taken properly.

Technique for High Sensitivity

In some cases, where higher sensitivity is required, the sample is arced. Two sample pins are used with ends machined to a cone with a 120° included angle. The arc is also used in determining the antimony content when the iron present is over 0.25 per cent, due to the interference of the iron line at this concentration when the spark source is used. The nature of this interference is the formation of a variable background from the iron line in the neighborhood of the antimony line on the photographic plate.

The plate is then developed, the selected lines read on the densitometer, and the percentage transmission values converted directly into per cent concentrations by the use of specially constructed calculating boards. The analytical scales of the calculating boards are made by extending the curves of Fig. 3 on to a straight line, and arranging these scales on the board so that the "index points" lie on the same vertical line. The index point is that value of the concentration for a particular element for which the corresponding relative intensity has the value one or unity.

The plate characteristics are checked whenever a new batch of plates or when a new supply of developer are used. The standard sample sparked on each plate also is used as an indication of any changes in plate characteristics. A typical plate calibration curve is shown in Fig. 2. The complete conditions as used in the analytical procedure are given in Table 4.

The line pairs used for the red brass alloys are given in Table 5. Fig. 3 shows the analytical curves for 85-5-5-5 alloy as typical of this group.

Standard Sample Corrects Difficulty

One particularly annoying factor encountered in analytical work from time to time is the apparent shift of the analytical curves, even though all conditions are maintained as constant as possible. This necessitates the use of a standard sample on each plate which is about the only effective means of dealing with the difficulty. Other workers [8] have found this to be true and up to date no definite cause for the shift has been found. More investigations are planned to determine if there is a single cause or whether it is the result of a number

TABLE 11.—COMPARATIVE RESULTS ON HIGH STRENGTH MANGANESE BRONZE

	Fe, per cent	Al, per cent	Mn per cent
S.A.	2.65	5.80	3.25
C.A.	2.68	5.76	3.18
	2.60	5.85	3.30
	2.82	6.07	3.40
	2.55	5.40	3.35
	2.75	5.85	3.27
	3.60	5.65	3.80
	3.55	5.60	3.80
	2.35	5.80	3.10
	2.27	5.75	3.40
	2.75	5.65	3.40
	2.73	5.80	3.36
	2.73	5.50	3.45
	2.82	5.60	3.51
	2.40	5.63	3.15
	2.32	5.63	3.09
	2.50	5.85	3.25
	2.48	5.71	3.24
	2.45	5.80	3.10
	2.26	5.70	3.18
	2.45	6.00	3.20
	2.14	5.77	3.14

of factors. This curve shift is not serious for concentrations below one per cent, but may be considerable for values from 1 to 10 per cent.

Results

Tables 6 and 7 give the results as determined on two samples over a period of months. They served as daily check standards and indicate the reproducibility of the method used since in this case no corrections were made for curve shifting which is sometimes found as mentioned above.

Check results as accumulated over a period of time are given in Tables 8, 9, 10, 11 and 12 for some of the alloys that were run both spectrographically and chemically. In each case the spectrographic values are shown above the corresponding chemical values.

Discussion

Figures 4 and 5 show in block diagram the precision and accuracy of the iron, nickel and antimony determinations for the 85-5-5-5 alloy. This alloy represents a major proportion of our production and considerable data are available for study. Deviations in both figures are expressed as the difference in results between chemical and spectrographic analysis on the same sample and are given in actual hundredths percentage values.

Figure 4 represents a total of 125 determinations made on the same sample over a period of months and on many different plates. The average deviation for this sample was $\pm$ 4 per cent of the amount present for the elements iron, nickel and antimony.

The data for Fig. 5 was taken from production records and includes about 110 different samples which were run by the spectrographic and chemical laboratories. Deviations are again expressed in hundredths of a per cent and the average deviation for each element is about $\pm$ 3 per cent. The average deviation is a little less than for the precision of the method, because corrections for the apparent index point shift are made in production work. Results for the higher concentrations, as shown in Tables 8, 9, 10, 11 and 12 in the range 1 to 10 per cent, usually show a deviation of about 3 per cent under routine conditions.

Conclusions

The spectrograph has been adapted to many of the processes involved in the manufacture of brass and bronze ingots and has proved to be invaluable in performing the tasks to which it has been applied. Closer control over many elements and savings both in time and operating costs have been realized.

The success of quantitative analyses may be ascribed to several factors.

1. Strict control over all external conditions affecting the analytical procedure, such as air conditioning, temperature control of developing solutions, voltage regulation of the source unit and densitometer, and sampling method.
2. The use of carefully analyzed standards for each alloy.
3. Frequent checks on analytical curves and plate characteristics by the use of standards.
4. Recognition of limitation of the method.

TABLE 12.—COMPARATIVE RESULTS ON ALUMINUM BRONZES

	Fe, per cent	Al, per cent	Zn, per cent	Mn, per cent	Ni per cent
S.A.	4.20	10.10	0.15	0.30	2.25
C.A.	4.13	10.11	0.10	0.34	2.28
	4.00	9.63		0.28	2.10
	3.92	9.43		0.31	1.92
	4.03	9.55	0.17	0.27	2.00
	4.36	9.25	0.17	0.27	1.92
	4.05	10.20	0.16	0.27	2.00
	4.03	10.38	0.16	0.27	1.85
	3.80	10.90		0.46	0.57
	3.83	10.88		0.41	0.56
	3.95	9.30	0.18	0.24	2.05
	3.87	9.09	0.20	0.25	2.03
	2.65	10.70			
	2.81	10.50			
	3.92	9.80		0.39	2.06
	3.94	10.00		0.36	2.12
	3.95	9.90			3.40
	4.17	9.96			3.38
	3.80	11.10	0.09	0.04	0.09
	3.93	11.23			

Acknowledgments

The success of the quantitative work is due in great measure to the many and careful chemical analyses made in investigational work and in preparation of the standard samples. The cooperation of A. B. Shapiro, chief chemist, and members of his staff is greatly appreciated.

Acknowledgment is also given Miss Ruth Orensten for assistance in collecting data and to H. Kramer and Company for permission to publish this paper.

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APPRENTICE CONTEST STIMULATES INITIATIVE, TESTS TRAINING

F. C. Cech
Cleveland Trade School
Cleveland

THE A.F.A. Apprentice Contest was started in 1924 as a gesture of appreciation for the teaching being done by the Milwaukee Vocational School. At a board meeting during the A.F.A. convention held in Milwaukee that year, the National Directors set up prizes totaling $45. All the boys in the contest were apprentices of Allis-Chalmers Mfg. Co.

Since 1924 the A.F.A. Apprentice Contest has been an annual affair. Increased interest on the part of apprentices and management and recognition of the value of the contest have resulted in prizes of $100, $50 and $25 being offered for first, second and third place in each of the following contest divisions: gray iron molding, steel molding, nonferrous molding and patternmaking. Lack of apprentices among the malleable foundries has made it unnecessary, so far, to set up a malleable molding division. The nonferrous molding division covers copper-base alloys and the light metals, the total number of entries in this division of the national contest not being sufficiently large to warrant setting up two divisions.

In addition to the cash prizes, all winners receive certificates and the first prize winners have their round-trip rail fare paid to enable them to attend the annual A.F.A. Convention where they receive their awards at the Annual Meeting.

The contest is open to all indentured apprentices who meet entrance requirements * and is carried out locally on a plant or chapter basis. The best local entries are sent to the national contest where a group of experienced foundrymen and patternmakers select the winners.

Because of increased interest, the 1948 contest will open December 1. Contestants can be registered at any time to make use of the patterns and blueprints which will be available on the opening date.

Why has the annual A.F.A. Apprentice Contest been so successful? Why do apprentices look forward to the competition each year? What is management's stake in the contest? Why do A.F.A. Chapter Educational Committees plan months ahead for the local contest? How are the patterns and blueprints selected and by whom? What can be learned from past contests?

Contest Objectives

Its success and the continually growing enthusiasm for the contest result from satisfying the objectives of the contest, which are: (1) to stimulate interest in apprenticeship and apprenticeship training, (2) to cultivate an appreciation for craftsmanship, (3) to induce apprentices to develop skill and accuracy by arousing a desire for improvement, and (4) bring out the importance of the time element involved in producing a good piece of work.

Management in a number of plants frequently expresses enthusiasm for the contest because it offers a means for comparing skill and quality of training with other plants. The contest has also served to eliminate over-confidence from some apprentices, a valuable service from the point of view of both management and apprentices.

This was brought out by Martin Putz, who entered the 1938 contest as an apprentice of Fairbanks, Morse & Co., Beloit, in an article in page 10 of the December 1938 issue of AMERICAN FOUNDRYMAN.

"Judging the contest from its beneficial stand point," he wrote, "we can say frankly that it made three outstanding impressions. First, it checked an over-abundant self-confidence, which only too often tends toward leading one to failure instead of success. Second, it instilled a spirit of competition among the apprentices themselves. Last, and of great importance, it inculcated a desire for individual initiative."

Winning one of the first places in the contest included, for the first time in 1946, a trip to the annual A.F.A. convention with round-trip rail fare paid by the Association. The comments and observations of these winners confirm the value of the A.F.A. Annual Apprentice Contest.

Referring to the 1946 contest and 50th Anniversary Convention, C. Corriveau of Montreal Technical School, first prize winner in the nonferrous molding division, urges all apprentices to take part in A.F.A. competitions. He writes, "I can as-

Tips for contestants make up an important part of this discussion of the annual A.F.A. Apprentice Contest. The value of the contest is brought out by comments of contest winners which are surprisingly similar to comments made from time to time by management, by contest judges and by the A.F.A. Apprentice Contest Committee.

* Contest regulations and instructions for entering the contest can be obtained from American Foundrymen's Association, 222 West Adams Street, Chicago 6, Ill.

sure them that the chance of attending the convention is well worth the effort expended."

Robert Bina, Crucible Steel Casting Co., Cleveland, who won first place in the steel molding division in 1946 and Raymond Dragon, Western Pattern Works, Montreal, winner of the first prize in the pattern division, also are enthusiastic about the apprentice contest and they enjoyed the convention technical sessions. "The lectures were very educational," according to Dragon.

Contestants' Interest

The feelings of the four contest winners have been particularly well expressed by Lawrence Kinsinger, Caterpillar Tractor Co., Peoria, winner of first place in the gray iron molding division. Like Bina, he has won first place in his division in two A.F.A. Annual Apprentice Contests. Kinsinger writes:

"The magnitude of the exhibits and the innovations of foundry equipment made a great impression on me at the convention. The addresses of the educators, naval and army men, and foundry management personnel were most educational. I gained much from my contacts with the management personnel, and men from companies who supply foundry industries.

"Meeting some of my former colleagues, I learned that some had become manufacturing superintendents. This shows that there are no peers in the foundry except those we make ourselves.

"The exhibitors were cordial in discussing foundry practices, and I recall the outstanding equipment. There was the rapid baking of cores by a new process. The two to three minute baking time is an advantage and the oven is relatively small, hence it would save much precious core room space.

"The use of matchplates with the molding surface $\frac{1}{32}$ in. narrower than the inside width of the flask provided castings with only a trace of a fin around the parting. Such a plate would be good for use in making castings tending to crush.

"Another exhibitor had two women making cores with a small blowing machine. They seemed to make many cores with the small amount of equipment involved and in a short time too.

'There were sand vibrating chutes which literally vibrated the sand up an incline. The larger variety of chutes could move small castings.

"One technical paper was devoted to safety and hygiene in relation to dust control and the various types of equipment used. This is an important subject in the effort to make the foundry a good place to work.

"The papers presented by the lecturers were very educational and usually of a very technical nature. Every company seemed to have a different method of apprentice training and I believe it would be helpful to apprentices if the American Foundrymen's Association helped the firms to standardize their programs to a greater extent. Also, the government has made provisions to subsidize veteran trainees, and each employer should try to set up a program which complies with this law for the benefit of themselves and the trainees.

"It was surprising to note that the A.F.A. Apprentice Committee had great interest in indentures in 1897 as they also have today. Reading the report of 1897 at the 50th Anniversary Convention brought out the necessity for adequate training to maintain high standards of workmanship in the foundry industry. This is the same as the committee is striving for today.

"It was a pleasure to meet the other contest winners and discuss our training schools. I was interested in Canadian procedures, and discovered they are quite similar to ours. It was profitable to study the other contest castings and compare the gating methods, time, and soundness.

"It is with great appreciation toward my company that I acknowledge the opportunity of participating in the contest, and thank A.F.A. for the splendid trip. I found it very enjoyable and educational. It is an honor that apprentices should deem very worthwhile."

Pattern Selection

How are the patterns and blueprints selected and by whom? Each year the Apprentice Contest Committee of the Educational Division meets to select the blueprints for the coming year's contest. The committee, under the chairmanship of Ed Pierie, plant superintendent, Motor Pattern Co., Cleveland, has already made the selections for the 1948 contest.

Some of the considerations involved are: Can the casting be poured from a single hand ladle? Does it require an uneven parting to be cut? Will the apprentice have to demonstrate knowledge of the principles of controlled directional solidification? Can the pattern be molded several ways to give the apprentice an opportunity to display his ingenuity?

After blueprints for the various molding contests have been selected, they are sent to several industrial and school pattern shops where patterns and coreboxes are made. These patterns and core boxes are then routed to the contestants.

In choosing a blueprint for the pattern division of the contest, the committee tries to select a project which can be completed in approximately eight hours. The project must require an apprentice to display knowledge of the basic principles of patternmaking and ability to handle tools. It must also require him to show a familiarity with foundry processes and principles of castings production.

Committee May Modify

Sometimes a blueprint for the molding projects or for patternmaking does not meet all these requirements. The committee then introduces the missing element by modifying the blue print or simplifies an unduly difficult project by eliminating a troublesome contour.

Contestants and all others interested in the A.F.A. Apprentice Contest and in apprentice training will do well to read the articles listed at the end of this discussion. These articles contain helpful suggestions for carrying out local contests and judges comments on entries of previous years as well as illustrations of projects.

Some comments have been made so frequently by contest judges and observers that it may be well to repeat them here.

Patterns. Center lines were missing or not carried over to parting line. Short grain construction should be avoided. Draft should be sufficient but not too much. Excessive taper makes core-setting difficult. Witness-marks should be large

enough to make a difference in core setting but not so large that they make molding or core setting difficult. Loose pieces should be properly seated.

Castings. Molders should strive for high yield consistent with soundness. Select sand and ram carefully to avoid swells, scabbing, cuts and washes, etc. Cut parting lines carefully to avoid finning. Place gates and risers so they may be removed with least difficulty. Draw the pattern and close the mold with care.

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SOUTHERN CALIFORNIA LEADER APPOINTED A. F. A. DIRECTOR

THE A.F.A. Board of Directors at its recent meeting appointed Robert Gregg, foundry manager, Reliance Regulator Corp., Alhambra, Calif., to the Board to fill the unexpired term of G. K. Dreher. Mr. Dreher resigned from the A.F.A. Board in order that he may devote

R. R. Gregg

all his time to his new position as Executive Director of the Foundry Educational Foundation.

Mr. Gregg is well-known in A.F.A. circles. He was one of the organizers of the Southern California chapter and served as its first chairman. He came to this country in 1907 and worked in several iron, steel and non-ferrous foundries as a molder and coremaker. He has been associated with Reliance since 1927 when he joined the firm as foundry superintendent. A member of A.F.A. since 1919, he has attended almost all exhibit conventions since that time.

The above appointment was filled by the board in accordance with the By-Laws of the Association, Article 6, Section 2. "Should a vacancy occur in the Board of Directors, or in any of the elected offices, except the office of President, through death, resignation or other cause, the Board of Directors may select a member of the Association to fill the vacancy until the next annual election."

IBF Publishes Annual Proceedings

THE INSTITUTE of British Foundrymen has recently published its *Proceedings.* This volume, number 39, contains the papers presented to the Forty-third Annual General Meeting of the Institute and a selection of the papers presented to the branch meetings held during 1945-46. Copies of the issue may be obtained from the Institute of British Foundrymen, St. John St., Chambers, Deansgate, Manchester 3, England.

Select Nominating Committee for 1948

SELECTION OF THE 1948 Nominating Committee to nominate National Officers and Directors for the coming year was made by the Executive Committee of the Board of Directors at a meeting in Chicago July 29. The following Nominating Committee was appointed, in accordance with the by-laws:

Chairman, Past President S. V. Wood, Minneapolis Electric Steel Castings Co., Minneapolis.

Past President F. J. Walls, International Nickel Co., Detroit.

L. E. Roby, Peoria Malleable Castings Co., Peoria, Ill.

L. D. Wright, U. S. Radiator Co., Geneva, N. Y.

Wm. M. Ball, Jr., Edna Brass Div., Magnus Metal Co., Cincinnati.

R. F. Lincoln, Russell F. Lincoln Co., Cleveland.

Earl M. Strick, Erie Malleable Iron Co., Erie, Pa.

Henry B. Hanley, American Laundry Machinery Co., Rochester, N. Y.

Robert R. Haley, Advance Aluminum & Brass Co., Los Angeles.

The by-laws of the Association provide that the Nominating Committee shall be largely selected from names of candidates submitted by eligible A.F.A. chapters prior to July 1 each year, eligible chapters having had no representation on a Nominating Committee during the two previous years. From the list of candidates thus submitted the Executive Committee is empowered to appoint "a Nominating Committee of seven members, six of whom shall be from the list of eligible candidates submitted by the various local chapters," and one may be a member not in a chapter territory. These seven, together with the last two living past presidents, constitute a Nominating Committee of nine.

The by-laws also require that the personnel of the Nominating Committee be published to the membership within 45 days following appointment. It is expected that the committee will meet shortly after the first of the year to make its selections of new officers and directors.

MECHANIZED SAND UNIT AIDS FOUNDRY COURSES

Harry R. Dahlberg
Assistant Professor
Oregon State College
Corvallis, Ore.

FOUNDRY PRACTICE has been sadly neglected in engineering schools throughout the country in spite of the fact that the foundry industry is one of the basic industries in our modern civilization. Every industry using castings is directly dependent upon the foundry industry. Most all industries are at least indirectly dependent upon castings—few machines are made without them. Yet hundreds—perhaps thousands—of engineers leave our institutions uninformed of the science of casting metals and the problems that the foundrymen have in producing castings so necessary to our highly mechanized world.

In the industrial shops of our engineering schools will be found thousands of dollars worth of machine tools in the machine shops. Good machine tools are essential in training engineers. In the forging and welding shops will be found equipment necessary to teach modern methods of fabrication of steel. The school foundry, however, often is not equipped with a cupola or has an old one which has seen better days. Worn-out or obsolete equipment and a pile of sand usually complete the picture.

Is it any wonder then that student engineers do not develop an interest in a foundry career from such an environment?

School Shops Modernized

Several years ago, the school of engineering at Oregon State College started a program of shop modernization. Modernization of the foundry started at the sand pile. Utilizing the NYA labor and directed by Donald L. Mason, then instructor of foundry practices at Oregon State, construction of a sand-handling and conditioning unit was started. The objectives were:

1. To provide storage space for molding sand so that floor space could be used for laboratory work.
2. To eliminate the time and labor involved in conditioning the sand by hand.
3. To condition the molding sand mechanically so that better castings would result.
4. To give the students an opportunity to operate a sand-handling and conditioning unit.

Included in the system is a stationary grate shakeout at floor level, a conveyor and elevator system to carry the

View of sand conditioning and handling unit showing floor shakeout, elevator, storage bin, and sand muller.

Photograph of room below the shakeout showing conveyor carrying sand to bucket elevator, the sand passing over magnetic pulley to remove metallic particles.

sand from the shakeout, over a magnetic pulley to separate the metal particles and through a screen into a storage bin above the mixer. A dust exhaust fan at the top of the elevator evacuates dust from the entire conveyor system and keeps the room relatively free from dust. As the sand is discharged into the bin it passes over a vibrating screen which eliminates all large lumps and metal particles not previously removed by the magnetic pulley.

A sand-measuring device above the mixer prevents overloads in the mixer and aids in proportioning the moisture and seacoal to be added. The conditioned sand is discharged from the mixer to a hopper below, conveniently placed for distribution to the molding floor or benches, through an aerator, thus supplying properly conditioned sand at the point of use.

Acquaint Students With Mechanization

Each student actually operates the unit at least once during the initial course. He elevates and mixes the sand for the class and performs any maintenance work necessary. During the fall quarter just past, there were 13 laboratory periods per week (including four night classes) and the cupola was operated four times a week. Without the sand conditioning unit this would not have been possible because half of the time would have been consumed conditioning sand by hand. It does not remove the shakeout but it eliminates some of the arduous tasks in the foundry and the students get an idea of the value of mechanization first hand.

There are several changes to be made before the unit operates perfectly. The sand should be aerated and the vibrating screen redesigned. Other than these two problems the unit has proved quite satisfactory. It has saved the time and labor formerly consumed in hand sand conditioning, allowed more frequent operation of the cupola and resulted in the production of better castings.

What did it cost? Very little.

What is it worth? We cannot evaluate it in dollars and cents because we are not operating on a production basis. Our students do not become journeymen while they study foundry practices. They are not studying to become journeymen. They are future engineers.

Cast Bolts for Pipe Joints

(Continued from Page 27)

sections up 1½-in. diameter. Annealing at about 1800 F decomposes most of the combined carbon to produce a soft, tough austenitic malleable iron (Fig. 8). This metal has a tensile strength of about 70,000 psi, as compared to about 30,000 psi for sand cast nickel alloy, and significantly higher ductility.

Austenitic malleable bolts, especially when coupled with plain iron as in a pipe joint, possess corrosion resistance comparable to that of bronze or stainless steel in most services. Table 3 shows the results of an accelerated electrolytic corrosion test made on joint sections bolted with several types of bolts. This is a very severe type of test. With lower current, or no current, there is a much greater superiority of the last two materials shown in the Table.

TABLE 2—ACCELERATED CORROSION TEST OF STANDARD COPPER ALLOYED BOLT IRON WITH PLAIN IRON

One week in 5 per cent Sulphuric acid each specimen—one coupled bolt and nut

Specimen	Part	Loss in Weight grams	per cent	g. per cm²
No. 1	Standard bolt....	10.6	3.4	0.13
	Standard nut.....	18.5	24.6	0.77
	Total...........	29.1	7.6	0.28
No. 2	Standard bolt....	12.6	4.2	0.16
	Plain iron nut....	22.2	30.7	0.92
	Total...........	34.8	9.3	0.34
No. 3	Plain iron bolt....	71.0	22.2	0.89
	Standard nut.....	20.2	27.2	0.86
	Total...........	91.2	23.3	0.87
No. 4	Plain iron bolt....	61.9	21.9	0.77
	Plain iron nut....	32.1	45.1	1.37
	Total	94.0	26.7	0.91
Averages	Standard bolts....	11.6	3.8	0.14
Averages	Plain iron bolts...	66.4	22.6	0.83
Averages	Standard nuts....	19.4	25.9	0.82
Averages	Plain iron nuts...	27.2	37.2	1.22

TABLE 3—ELECTROLYTIC CORROSION TEST OF JOINTS OF 3-IN. CAST IRON PIPE BOLTED WITH DIFFERENT BOLT MATERIALS

Bolt Material	Loss in weight, per cent Bolts and Nuts	Entire Joint
Mild steel (black)..............	31.0	28.9
Cadmium plated steel	22.7	28.1
Galvanized steel................	16.1	26.4
Austenitic malleable............	3.5	27.4
18-8 stainless steel.............	2.1	26.4

Electrolyte: 2 per cent NaCl in water
Current: 0.9 amp. (average) from joint as anode to lead-lined tub as cathode.
Duration: 106 days.

Summary

Cast bolts for pipe joints are economically mass-produced by use of metal molds and short-cycle annealing. The bolts have desirable mechanical and corrosion resistant properties. An austenitic malleable bolt with unusual strength, ductility and corrosion resistance has been developed for special services.

FOUNDRY PERSONALITIES

H. S. Falk, president, Falk Corp., Milwaukee, has been elected to the board of Allis-Chalmers Mfg. Co., of the same city. He succeeds, as a director, his late uncle, Herman Falk. H. S. Falk has been associated with Falk Corp. since 1906, and was named its president in 1940. Active in several technical and fraternal societies, Mr. Falk is an A.F.A. Gold Medalist, (John A. Penton, 1939) and has served as a National Director.

C. K. Faunt, works manager of Christensen & Olson Foundry Co., Chicago, has been named president of the Non-Ferrous Founders Society, to serve out the unexpired term of the late **T. S. Hemenway.** Mr. Faunt is the present Vice-President of Chicago A.F.A. Chapter.

S. R. Ives and **H. D. Neill** were recently elected president and executive vice president, respectively, of Armco Drainage & Metal Products, Inc., Middletown, Ohio, and Armco Drainage & Metal Products of Canada, Ltd. Both firms are subsidiaries of American Rolling Mill Co. Mr. Ives joined the company in 1917 and was recently vice president-general manager of the Middletown subsidiary, with Mr. Neill, associated with the organization since 1926, as his assistant.

E. L. Stockdale, for the past ten years executive vice president of Universal-Cyclops Steel Corp., Bridgeville, Pa., has been elected president. He succeeeds W. H. Baker, who founded the firm in 1908 and served as its head until his death last June. Mr. Stockdale has been associated with the organization in various executive capacities for 33 years.

H. F. McVay was named president of Delhi Foundry Sand Co., Cincinnati, in the recent election of firm officers. Others elected are **Mrs. Lillian S. McVay,** vice-president; **Mrs. Ruth N. Smith Ray,** secretary-treasurer; **Charles Brahl,** sales manager, and **Harley McVay,** production mgr.

E. H. Perkins has been named president of the newly-organized Brooks & Perkins, Inc., Detroit. Other officers, who with Mr. Perkins constitute the board are: **O. N. Brooks** and **P. A. Day,** vice presidents; **K. C. Reeves,** treasurer, and **F. R. Seitz,** secretary. **C. W. Sponsel** is vice president in charge of fabrication; **H. W. Lucas,** assistant treasurer, and **C. I. Vogel,** sales manager. The firm has acquired and will continue the business of the former partnership, Brooks & Perkins.

D. W. Hopkins was recently named executive vice president, R-S Products Corp., Philadelphia. He will be in charge of the valve, furnace and manufacturing divisions. Associated with the firm since 1939, he was in charge of the valve division previous to the new appointment.

J. A. Kayser, has been named assistant to the president, Laclede-Christy Clay Products Co., St. Louis. He has been with the firm for 24 years and has served in the research, operating and sales departments.

H. S. Falk

J. A. Kayser

J. W. Kinnear, Jr., has resigned as assistant manager, Pittsburgh district of Carnegie-Illinois Steel Corp., to accept the position of executive vice president, Firth Sterling Steel & Carbide Corp.

J. H. Smith, formerly assistant sales manager of General Electric X-Ray Corp., New York, recently joined Chicago, as assistant to the president. He is a graduate of the University of Pennsylvania, Philadelphia, where he was an All-American football player; and he was at one time associated with Cramp Shipbuilding Co., of that city, as procurement manager.

F. W. Gardner resigned recently as chief industrial engineer, Wilson Foundry & Machine Co., Pontiac, Mich., to join Management Engineer Research Institute, Detroit, as vice president, a position he held before joining the Wilson firm.

T. J. Moore, Jr., has been elected a vice president and director of Sharonsteel Products Co., Dearborn, Mich. The firm is a wholly-owned subsidiary of Sharon Steel Corp., Sharon, Pa.

Dr. F. C. Croxton, Dr. C. H. Lorig, Dr. H. W. Russell, R. A. Sherman, C. E. Sims, and **J. D. Sullivan,** have been named assistant directors of Battelle Memorial Institute, Columbus, Ohio. Mr. Sims, a past National Director and the 1945 John A. Penton Gold Medalist of A.F.A., and Dr. Lorig, who has served as Chairman, Steel Division, are well known to A.F.A. members and to the foundry field. They have conducted many technical investigations, have written numerous papers and have participated as speakers and discussion leaders at meetings and conferences on foundry technology.

Dr. C. H. Lorig

C. E. Sims

A. L. Sonnhalter, for the past 15 years vice president of Crucible Steel Co. of America in charge of the Pittsburgh Crucible Division, Midland, Pa., has resigned because of ill health. He continues as a director and consultant. Joining Crucible Steel in 1922 as superintendent of the open hearth department at Midland, Mr. Sonnhalter advanced to superintendent of the steel works in 1924; assistant general superintendent of the entire Midland works in 1926, and general superintendent in 1928. He was elected vice president in 1932.

F. A. McCarthy, vice president-general manager of Forem Distributors, Inc., Buffalo, N.Y., was recently appointed dealer for industrial apparatus manufactured by North American Philips Co. His territory will include 14 counties in western New York and 7 in northwestern Pennsylvania.

S. J. Moran, who joined Blaw-Knox Co., Pittsburgh, as an office boy with Union Steel Castings Div. more than 25 years ago, has been appointed works manager of the division. He is succeeded as assistant treasurer and production manager by **J. L. Dougherty,** previously division auditor.

W. C. Krecklow, who started as an office boy with Allis-Chalmers Mfg. Co., Milwaukee, in 1910, has been named production control manager of the firm's West Allis general machinery works. He succeeds **H. A. Wallace,** resigned, and is himself succeeded as electrical manufacturing division superintendent by **A. A. Ryan,** recently a general foreman, electrical shops.

G. E. Clark has been appointed superintendent of Dussault Foundry Corp., Lockport, N.Y. He has been superintendent of Lynch Foundry Corp., Anderson, Ind., for the past four years and was previously in charge of foundry operations at the Defiance (Ohio) Machine Works.

D. A. Griffith, formerly with the U. S. Bureau of Mines, has joined Allis-Chalmers Mfg. Co. as assistant to the general manager of the Pittsburgh works.

A. B. Agnew has been named general manager of Osceola Silica & Firebrick Co., Osceola Mills, Pa., by Laclede-Christy Clay Products Co., St. Louis, Mo., which has purchased the capital stock of the Pennsylvania firm. He was recently with the general office of Harbison-Walker Refractories Co., Pittsburgh, Pa.; had previously acted as superintendent of plants in Penn-

(Continued on Page 84)

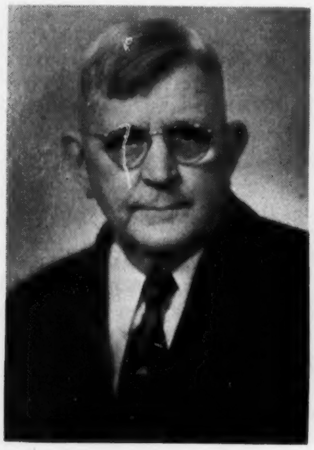
CHAPTER OFFICERS

John E. Wilson
Climax Molybdenum Co.
Los Angeles
Secretary
Southern California Chapter

Dr. J. T. MacKenzie
American Cast Iron Pipe Co.
Birmingham
Vice-Chairman
Birmingham District Chapter

R. S. Davis
National Malleable & Steel
Castings Co.
Indianapolis
Director
Central Indiana Chapter

W. W. Bowring
Frederic B. Stevens, Inc.
Detroit
Chairman
Detroit Chapter



W. C. Fleming
Hughes Tool Co.
Houston, Texas
Director
Texas Chapter

I. F. Cheney
Griffin Wheel Co.
St. Paul, Minn.
Vice-Chairman
Twin City Chapter

O. L. Voisard
Robert Mitchell Co. Ltd.
Montreal, Que., Canada
Vice-Chairman
E. Canada & Newfoundland Chapter

M. G. Winters
Winters Foundry & Machine Co.
Canton, Ohio
Director
Canton District Chapter

H. W. Meyer
General Steel Castings Corp.
Granite City, Ill.
Treasurer.
St. Louis District Chapter

W. A. Hallberg
Lakey Foundry & Machine Co.
Muskegon, Mich.
Vice-Chairman
Western Michigan Chapter

F. L. Weaver
Weaver Material Service
Buffalo, N.Y.
Secretary
Western New York Chapter

B. M. Loring
Naval Research Laboratory
Bellevue, Wash., D.C.
Vice-Chairman
Chesapeake Chapter

★ NEW A. F. A. MEMBERS ★

July 15 - August 15 - As the recent heat wave covered the country so did the Detroit chapter membership committee cover its territory and turn up with 20 new A.F.A. applicants. Things were almost as warm around Chicago as their total shows 12 new members. The Southern "Cal" boys countered with an addition of 9. Last year over a somewhat similar space of time, Southern California held first position with Cincinnati District and Metropolitan scoring a second and third. Will your chapter be among the top three next month?

BRITISH COLUMBIA CHAPTER

***Letson & Burpee Ltd., Vancouver, B.C. (G. M. Letson, Mng. Director)**
A. Bourassa, Plant Supt. British Columbia Tube Works, Barnaby, B.C.
Herbert Heason, Fdry. Supt., Heaps Eng. (1940) Ltd., New Westminster, B.C.
P. H. H. Hookings, Met. Engr., Major Aluminum Products Ltd., Vancouver, B.C.

CANTON DISTRICT CHAPTER

L. A. Weaver, Met., United Eng. & Fdry. Co., Canton, Ohio.

CENTRAL INDIANA CHAPTER

Henry Bergman, Hoosier Iron Works, Kokomo, Ind.
E. C. Hearn, Supt., Federal Foundry Co., Indianapolis.
J. C. Metelko, Asst. Fore., International Harvester Co., Indianapolis.
Richard Overholser, Fore., Melt. Dept., Central Foundry Div., Danville, Ill.

CENTRAL MICHIGAN CHAPTER

S. J. Calvarnso, Hard Iron Insp. Fore., Albion Malleable Iron Co., Albion.
H. C. Green, Owner, Battle Creek Pattern Works, Battle Creek.
Robert H. Pinckel, Albion Malleable Iron Co., Albion, Mich
Kirk Richtmeyer, Instr. Tech., Albion Malleable Iron Co., Albion.
Arthur J. Schmitke, Sales Mgr., Fdry. Div. Novo Engine Co., Lansing.
W. H. Sutten, Core Room Asst., Fuller Mfg. Co., Kalamazoo.
E. D. Williams, Chief Draftsman, Albion Malleable Iron Co., Albion.

CENTRAL NEW YORK CHAPTER

Frederick Kuster, J. P. Ward Foundries, Inc., Blossburg, Pa.
B. J. Squires, Supt., Galeton Foundry Co., Inc., Galeton, Pa.

CENTRAL OHIO CHAPTER

Joseph C. Johnson, Marion Power Shovel Co., Marion.

CHESAPEAKE CHAPTER

J. W. Beale, Asst. Sand Supv., Lynchburg Foundry Co., Lynchburg, Va.
W. O. Becker, Field Engr., Atlantic Abrasive Corp., So. Braintree, Mass.
Ruth H. Hooker, Librarian, U. S. Naval Research Lab., Navy Dept., Wash., D.C.
M. R. Viar, Asst. Sand Supv., Lynchburg Foundry Co., Lynchburg, Va.

CHICAGO CHAPTER

A. R. Benoit, Appr., Greenlee Foundry Co., Cicero, Ill.
George Bowdish, Salesman, The Hill & Griffith Co., Chicago.
Daniel Byrne, Fdry. Supt., W. D. Allen Mfg. Co., Bellwood, Ill.
Roger Carlson, Pres., U. S. Pattern & Model Co. Inc., Chicago
H. R. Evans, Chief Clerk, Acct. Dept., International Harvester Co., Chicago.
C. E. Fralick, Asst. Chief Eng., Lester B .Knight & Associates, Inc., Chicago.
Raymond Grzeslakowski, Appr., Atlas Foundry, Chicago.
Curtis G. Klein, Acct. Supr., International Harvester Co., Chicago.
J. T. Llewellyn II, Exec. V.P., Chicago Malleable Castings Co., Chicago.
S. J. Podgorski, Fdry. Cost Clerk, International Harvester Co., Chicago.
Herzl Rosenson, R. Lavin & Sons, Inc., Chicago.
J. L. Webb, Spec. Appr., Sivyer Steel Casting Co., Chicago.

CINCINNATI DISTRICT CHAPTER

C. J. Dausch, Jr., Job Fore. of Foundry, The National Cash Register Co., Dayton, Ohio.
Anthony H. Kramer, Chairman of Bd., The Advance Foundry Co., Dayton, Ohio.
G. A. Kramer, Sls. Mgr., The Advance Foundry Co., Dayton, Ohio.
P. L. Ziegler, Gen. Mgr., The H. P. Deuscher Co., Hamilton, Ohio.

DETROIT CHAPTER

***Peninsular Grinding Wheel Co., Detroit (C. E. Price, Pres.)**
H. C. Bellak, Owner, American Red Star Co., Detroit.
B. J. De Boe, Engr., The Aluminum Co. of America, Detroit.
Robert Hamilton, Field Engr., U. S. Gypsum Co., Chicago.
W. H. Holcroft, Vice Pres., Holcroft & Co., Detroit.
D. L. Johnson, Jr. Ind'l. Engr., Penberthy Injector Co., Detroit.
F. E. Jones, Owner, J. W. Pattern Works, Detroit.
L. H. Kinney, Pttn. Engr., Chrysler Corp., Dodge Main Plant, Detroit .
W. I. Koskella, Chief Fdry. Engr., Giffels & Vallet, Inc., Detroit.
Ignace John Kumor, Gen. Fore., Detroit Steel Casting Co., Detroit.
R. C. Pierson, Met., Riley Stoker Corp., Detroit.
C. J. Richards, Chemist, Packard Motor Car Co., Detroit.
H. J. Richardson, Fact. Mgr., Penberthy Injector Co., Detroit.
David Sherwood, Jr., Engr., Sherwood Brass Works, Detroit.
Phil Simpson, Fore., Central Specialty Div., King-Seeley Corp., Ypsilanti, Mich.
M. H. Steinbrenner, Sales Engr., Swan-Finch Oil Corp., New York.
J. H. Strickland, Jr., Met., Aluminum Co. of America, Detroit.
M. W. Stusick, Chief Insp., Penberthy Injector Co., Detroit.
W. A. Teasel, Sales Repr., National Foundry Sand Co., Detroit.
Charles Yoman, Sand Control Tech., Michigan Steel Castings, Detroit.

EASTERN CANADA AND NEWFOUNDLAND CHAPTER

Georges Drolet, Molder, Shawinigan Foundries Ltd., Shawinigan Falls, Que.
Reuben Howse, United Nail & Foundry Co. Ltd., Newfoundland.

METROPOLITAN CHAPTER

***Production Pattern & Foundry Co., Chicopee, Mass. (Earl W. Jahn, Pres.)**
G. E. Maley, Jr., Met. Asst., American Brake Shoe Co., Mahwah, N.J.
W. A. Schoembeck, Sales Engr., J. O. Ross Engineering Corp., New York.
Joseph J. Warga, Works Met., Sperry Gyroscope Co. Inc., Great Neck, L.I., N.Y.
A. E. Winstead, Works Mgr., The Moore Brothers Co., Elizabeth, N.J.

MEXICO CITY CHAPTER

Alfredo Cruz Garcia, Fundicion Sabino, Donizzetti 161-Intiz, Vallejo, Calif.

MICHIANA CHAPTER

Alan Baines, Owner, A & B Pattern Works, Michigan City, Ind.

NORTHEASTERN OHIO CHAPTER

George Bauer, Pattern Dept., Fore., National Malleable & Steel Cstgs. Co., Cleveland.
L. C. Cole, Chief Engr., Osborn Mfg. Co., Cleveland
F. A. Dun., Fore., Babcock & Wilcox Co., Barberton, Ohio.
Charles H. Huletz, Sec., The Madison Foundry Co., Cleveland.
D. A. Kilpatrick, Sand Control Supv., Lake City Malleable Inc., Ashtabula, Ohio.

NORTHERN CALIFORNIA CHAPTER

E. R. Rowe, Sales Repr., Balfour Guthrie-Ltd., San Francisco.

NORTHWESTERN PENNSYLVANIA CHAPTER

***Cascade Foundry Co., Erie, Pa. (Charles F. Gottschalk, Vice Pres.)**
A. A. Engel, Supt., Cascade Foundry Co., Erie, Pa.
John Postirak, Fore., Cascade Foundry Co., Erie, Pa.
C. E. Wilcox, Prod. Mgr., Cascade Foundry Co., Erie, Pa.

ONTARIO CHAPTER

H. Antanow, Fdry. Fore., Clare Bros. & Co. Ltd., Preston, Ont.
J. C. Campbell, Contact Sls. Repr., General Smelting Co. of Canada, Ltd., Hamilton, Ont.
B. R. Hepburn, Mgr., Hartley Foundry Co., Brantford, Ont.
Albert R. Misener, Fdry. Prod. Supv., Cockshutt Plow Co. Ltd., Brantford, Ont.
J. E. Westbrook, Plant Supt., Canadian Brass Co. Ltd., Galt, Ont.

OREGON CHAPTER

Don M. Rotto, Sales Engr., Crawford & Doherty Fdry. Co., Portland, Oregon.
A. C. Woolley, Owner, Woolley Instrument Service, Portland, Oregon.

PHILADELPHIA CHAPTER

F. L. Mattson, Salesman, Hickman, Williams & Co., Philadelphia.

QUAD CITY CHAPTER

Frank M. Dickey, Mgr., John Deere Spreader Works, E. Moline, Ill.
Walter Mayer, Pttn. Shop. Fore., S & W Corp., Riverside Foundry, Bettendorf, Iowa.

ROCHESTER CHAPTER

Vincent J. Miller, Shipping Clerk, Hetzler Fdries, Inc., Rochester, N.Y.
H. Dwight Wood, Ingersoll-Rand Co., Painted Post, N.Y.

SAGINAW VALLEY CHAPTER

***Universal Engineering Co., Frankenmuth, Mich. (J. E. Wickson, Sec.-Treas.)**
G. W. Kellogg, Stud. Engr., Buick Motor Co. (G.M. Institute) Flint, Mich.
H. H. Miller, Buick Motor Div., G.M.C., Flint, Mich.
C. B. Taylor, Sand Tester, Buick Motor Co., G.M.C., Flint, Mich.

SOUTHERN CALIFORNIA CHAPTER

***Baroid Sales Div., National Lead Company, Los Angeles.**
Thomas F. Carolan, Supt., Rogers Pattern & Fdry., Los Angeles.
Louis Daigger, Partner, Becker Pattern Co., Los Angeles.
Harry Dok, Master Mechanic, Los Angeles Steel Casting Co., Los Angeles.

* Company Membership

W. L. Heater, Asst. to Gen. Mgr., National Lead Co., Baroid Sales Div., Los Angeles.
Roy J. Jones, Gen. Fore., Cast Iron Fittings Co., Los Angeles.
G. L. Ratcliffe, Gen. Mgr., Baroid Sales Div., National Lead Co., Los Angeles.
A. L. Waite, Field Engr., Macklin Co., Los Angeles.
A C. Withrow, Pres. & Gen. Mgr., Arthur C. Withrow Co., Los Angeles.

TEXAS CHAPTER

W. A. Bearden, Sales Repr., M. A. Bell Co., St. Louis.
G. H. Draper, Mgr., Precision Grinding Wheel Co., Inc., Philadelphia.

TWIN CITY CHAPTER

R. L. Catlett, Timestudy, Minneapolis Moline Power Implement Co., Hopkins, Minn.
Paul Kordiak, Jr., Asst. Supt., Scott-Atwater Foundry Co., Minneapolis, Minn.
L. K. Polzin, Director of Manufacturers' Secretariat, Minneapolis Chamber of Commerce, Minneapolis.

WESTERN MICHIGAN CHAPTER

Glen Stewart, Cadillac Malleable Iron Co., Cadillac, Mich.
Kenneth Strange, Cadillac Malleable Iron Co., Cadillac, Mich.
W. J. Way, Melting Clerk, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.
Clark E. Wheaton, Chief Met., Sealed Power Corp., Muskegon, Mich.
William Wilkinson, Cadillac Malleable Iron Co., Cadillac, Mich.

WISCONSIN CHAPTER

***K. J. Papke Co., Inc., Milwaukee, Wis. (K. J. Papke, Pres.)**
Mogens A. Adler, Sales Engr., Hewitt-Robins Inc., Robins Conveyors Div., Passaic, N.J.
J. A. Jeffreys, Fdry. Met., Fairbanks Morse & Co., Beloit, Wis.

* Company Membership

M. W. Prideaux, Fdry. Supt., Calumet & Hecla Consolidated Copper Co., Calumet, Mich.

OUTSIDE OF CHAPTER

S. V. Geer, Molder, Ross Meehan Foundries, Chattanooga, Tenn.
E. H. Cann, Fore., Foundry & Pattern Shop, The Panama Canal (Mech. Div.) Balboa, Canal Zone.

Hungary

Nehezipari Kozpont, Satjoosztalya, Budapest VI, Andrassy-ut. 12, Hungary.

India

J. H. Shah, Mukand Iron & Steel Works, Ltd., Badamibagh, Lahore.

Italy

S. P. S. Fiat, Div. Tecnica Progettativa, Ufficio Biblioteca, Torino

Scotland

David Henry Yound, 20 Balgonie Rd., Mosspark, Glasgow, S.W. 2.

South Africa

Christopher Batchelor, Gen. Fdry. Mgr., James Barwell (So. Africa) Ltd., Alberton.

Sweden

Sten Linander, Asst. Mgr., AB Limhamns Aduceringsverk, Limhamn, Malmo.
Lorens Lindqvist, AB Limhamns Aduceringsverk, Malmo.

Switzerland

Fritz W. Meyer, Dir. Dr. Engr., Sulzer Bros., Winterthur.

Turkey

***Bulent Buktas, Asst. Dire. Gen., The Sumerbank, Ankora.**

Personnel For The 1948 Convention Committee Is Named

THE PRELIMINARY step toward the formation of convention committees has been undertaken by the A.F.A. Philadelphia chapter with the appointment of personnel to the general convention committee. General chairman is A.F.A. National Director John M. Robb, Jr., Hickman, Williams & Co., Philadelphia, and past chairman of the Philadelphia chapter. William Morley, Link-Belt Co., Philadelphia, has been appointed general vice-chairman and also selected to serve on the committee are: W. B. Wilkins, American Manganese Bronze Co., Philadelphia; Stanley Kirn, M. L. Kirn & Bro., Philadelphia; T. J. Gerwig, Republic Steel Corp., Philadelphia; H. L. McClees, Crucible Steel Casting Co., Lansdowne, Pa.; G. F. Pettinos, Jr., G. F. Pettinos, Inc., Philadelphia, and B. A. Miller, The Baldwin Locomotive Works, Philadelphia.

As was announced in the July issue Philadelphia, one of the leading and most progressive foundry centers of the country, will again be host to the members of the foundry industry of North and South America as well as countries from abroad. After a thirteen year period and on the anniversary of its fifty-second year, the American Foundrymen's Association returns to Pennsylvania's large industrial metropolis May 3 to 7 to stage a major convention and exhibition of foundry equipment and supplies.

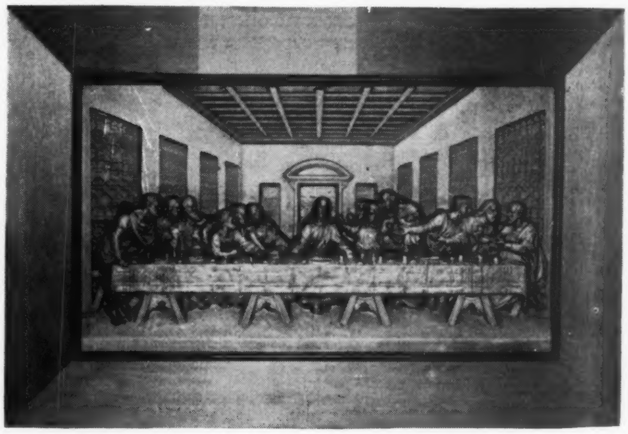
Convention Hall Houses Exhibits

The exhibit and most convention meetings will be held in the Philadelphia Convention Hall and Commercial Museum, with evening sessions and other events scheduled for downtown hotels.

Since its organization in 1935, the A.F.A. Philadelphia chapter has been outstanding. Backed by an enthusiastic membership and guided by capable officers, the chapter is embarking upon a program which not only will benefit materially those participating directly in the work, but cannot help but be reflected in the service the parent body provides for its members. Committees of the Philadelphia chapter will arrange programs to permit those attending the convention to view the foundry industry as well as many other features of interest at first hand.

The wide variety of castings shops offers unusual opportunities for plant inspection. A number of plants will be open for inspection at various times during the convention week. Detailed schedule of visitations will be published at a later date in AMERICAN FOUNDRYMAN.

A ladies entertainment program will be arranged for the ladies attending the convention. The committee will extend a cordial invitation to the ladies.



The plaque shown here, which is "The Lord's Supper," was on display at the Old Timer's and Apprentice's Dinner held by the Wisconsin chapter recently. The gentleman responsible for this piece of art is Mathias Leven, 68 years old, and associated with Allis-Chalmers Mfg. Co., Milwaukee. He molded this himself in 1912 while at the ship yard foundry, Kiel, Germany. The pattern was carved by hand by the "lost-wax" process. The casting weighs 24 lb and actual size is 18-in. x 28-in.

CHAPTER DIRECTORY

1947-48 SEASON

Birmingham District Chapter
(Established 1936)

Chairman—W. E. Jones, Chief Engr., Stockham Pipe Fittings Co., Birmingham 2.

Vice-Chairman—Dr. J. T. MacKenzie, Dir. of Met., American Cast Iron Pipe Co., Birmingham.

Secretary-Treasurer—Fred K. Brown, Sales Mgr., Adams, Rowe & Norman, Inc., Birmingham.

Directors—Terms Expire 1948

Thomas Bellsnyder, Pres., Jefferson Foundry Co., Birmingham 6.
T. H. Benners, Jr., T. H. Benners & Co., Birmingham.
C. P. Caldwell, Pres., Caldwell Foundry & Machine Co., Inc., Birmingham 1.
Dan B. Dimick, Jr., Mgr., Dimick Casting Co., Birmingham 4.
J. E. Getzen, Sales Engr., Whiting Corp., Birmingham 3.
Frank T. Hamilton, Pres., Rudsill Foundry Co., Anniston.
A. S. Holberg, Owner, A. S. Holberg Refractories, Inc., Birmingham.

Terms Expire 1949

J. T. Gilbert, Prod. Supt., Stockham Pipe Fittings Co., Birmingham.
Fred S. Middleton, Jr., Vice-Pres., Production Foundries Div., Jackson Industries, Inc., Birmingham 1.
J. A. Woody, Gen. Supt., American Cast Iron Pipe Co., Birmingham 2.

British Columbia Chapter*
(Established 1947)

Chairman—Norman Terry, Secy-Treas., Canadian Sumner Iron Works Ltd., Vancouver, B.C.

Vice-Chairman—Thos. Cowden, Mgr., Wm. McPhail & Sons, Ltd., Vancouver, B.C.

Secretary-Treasurer—L. P. Young, Met., A-1 Steel & Iron Foundry Ltd., Vancouver, B.C.

Directors

H. A. Sturrock, Managing Dir., Associated Fdry., Ltd., Vancouver, B.C.
J. S. Graham, Asst. Gen. Mgr., Mainland Fdry. Co., Vancouver, B.C.
J. A. Dickson, Owner, Dickson Fdry. Co., Vancouver, B.C.
Fred Bay, Fdry. Supt., Vivian Engine Works, Ltd., Vancouver, B.C.
F. B. Done, Mgr., Reliance Foundry Co., Ltd., Vancouver, B.C.
H. J. Turney, Mgr., Westland Iron & Steel Fdries., Ltd., Vancouver, B.C.
W. M. Armstrong, Asst. Prof., Mining & Metallurgy, University of B.C., Vancouver, B.C.

* New elections expected October, 1947.

Canton District Chapter
(Established 1944)

Chairman—C. F. Bunting, Fdry. Met., The Pitcairn Co., Barberton Ohio.

Vice-Chairman—E. H. Taylor, Plant Engr., F. E. Myers & Bros. Co., Ashland, Ohio.

Secretary—John L. Dickerson, Prod. Engr., The Pitcairn Co., Barberton, Ohio.

Treasurer—Otis D. Clay, Owner, Tuscora Foundry Sand Co., Canal Fulton, Ohio.

Directors—Terms Expire 1948

I. M. Emery, Wks. Mgr., Massillon Steel Casting Co., Massillon, Ohio.
Fred C. Glass, Frm. Brass Fdry., The Deming Co., Salem, Ohio.
Chas. Scoville, Babcock & Wilcox Co., Barberton, Ohio.
M. G. Winters, Owner & Gen. Mgr., Winters Foundry & Machine Co., Canton, Ohio.

Terms Expire 1949

G. M. Biggert, Met. Res. Dept., United Engineering & Foundry Co., Canton 5, Ohio.
T. W. Harvey, Chief Engr., The Pitcairn Co., Barberton, Ohio.
C. E. Shaw, Wks. Engr., American Steel Foundries, Alliance, Ohio.

Terms Expire 1950

J. W. Fairburn, Ashland Malleable Iron Co., Ashland, Ohio.
Nils E. Moore, Wadsworth Testing Laboratories, Canton 1, Ohio.
H. G. Stevener, American Steel Foundries, Alliance, Ohio.

Central Illinois Chapter
(Established 1945)

Chairman—A. V. Martens, Pres., Pekin Foundry & Mfg. Co., Pekin, Ill.

Vice-Chairman—F. W. Shipley, Fdry. Mgr., Caterpillar Tractor Co., Peoria, Ill.

Secretary-Treasurer—G. H. Rockwell, Caterpillar Tractor Co., Peoria, Ill.

Directors—Terms Expire 1948

C. W. Bucklar, Supt., Superior Foundry Co., East Peoria, Ill.
V. W. A'hern, Midwest Pattern Works, Peoria, Ill.

Terms Expire 1949

L. E. Roby, Supt., Peoria Malleable Castings Co., Peoria, Ill.
F. W. Shipley, Caterpillar Tractor Co., Peoria, Ill.

Terms Expire 1950

Zigmond Madacey, Fdry. Supt., Caterpillar Tractor Co., Peoria, Ill.
John M. McCarthy, Jr., Partner, South Side Foundry, Peoria, Ill.

Central Indiana Chapter
(Established 1939)

Chairman—Wm. Ziegelmueller, Vice Pres., Electric Steel Castings Co., Indianapolis.

Vice-Chairman—George Clark, Cummins Engine Co., Columbus, Ind.

Secretary—Jack Giddens, International Harvester Co., Indianapolis.

Treasurer—Paul V. Faulk, Electric Steel Castings Co., Indianapolis.

Directors—Terms Expire 1948

Harold H. Lurie, Chief Met., Cummins Engine Co., Columbus.
Fred Carl, Process Met., Delco-Remy Corp., Anderson.

G. C. Dickey, Works Mgr., Harrison Steel Castings Co., Attica.
L. C. Snyder, Res. Mgr., Hickman, Williams & Co., Cincinnati, Ohio.

Terms Expire 1949

R. S. Davis, Mgr., National Malleable & Steel Castings Co., Indianapolis.
Ray Fickenworth, Gen. Mgr., C & G Foundry & Pattern Works, Indianapolis 5.
Allen J. Reid, Sales Repr., General Refractories Co., Indianapolis 4.

Terms Expire 1950

Howard L. Creps, Frank Foundries Corp., Muncie.
J. P. Lentz, International Harvester Co., Indianapolis.
C. B. Juday, Perfect Circle Co., New Castle.
Robert Langsenkamp, Sec., Langsenkamp-Wheeler Brass Works, Indianapolis.

Central Michigan Chapter*

(Established 1947)

Chairman—Douglas J. Strong, Pres., Foundries Materials Co., Coldwater.
Vice-Chairman—Charles C. Sigerfoos, Assoc. Prof. of Mech. Engrg., Michigan State College, East Lansing.
Secretary-Treasurer—Fitz Coghlin, Jr., Met., Albion Malleable Iron Co., Albion.
Directors

Jack Durr, Tech. Adv. & Met., Albion Malleable Iron Co., Albion.
Edwin Doerschler, Pres., U. S. Foundry Corp., Kalamazoo 24.
Edward H. Schlepp, Riverside Foundry & Galvanizing Co., Kalamazoo 16.
John E. Wolf, Plant Mgr., Midwest Foundry Co., Div. L. A. Darling Co., Coldwater.
Oral J. Drumm, Fdry. Mgr., Battle Creek Bread Wrapping Machine Co., Battlecreek.
A. E. Rhoads, Pres., Engineering Castings, Inc., Marshall.
Charles Fike, Hardy Manufacturing Co.
C. W. Dock, Pres. & Mgr., Dock Foundry Co., Three Rivers.
Harry O. McCool, Fdry. Supt., American-Marsh Pumps, Inc., Battle Creek.

* New elections expected October, 1947.

Central New York Chapter

(Established 1939)

Chairman—R. A. Minnear, Fdry. Supt., Ingersoll-Rand Co., Inc., Painted Post.
Vice-Chairman—Curtis M. Fletcher, Fairbanks Co., Binghamton.
Secretary—J. F. Livingston, Asst. Plant Mgr., Crouse-Hinds Co., Syracuse.
Treasurer—David Dudgeon, Jr., Utica Radiator Corp., Utica.
Directors—Terms Expire 1948

L. E. Hall, Supt., Syracuse Chilled Plow Co., Inc., Syracuse.
Arthur C. Hintz, Sales Engr., Hines Flask Co., Troy.
Wm. A. Mader, Chief Met., Oberdorfer Foundries Inc., Syracuse.

Terms Expire 1949

D. J. Merwin, Vice-Pres., Oriskany Malleable Iron Co., Inc., Oriskany.
Wm. G. Parker, Fore. Sand Tech., Elmira Foundry Co., Inc., Elmira.
E. G. White, Plant Engr., Crouse-Hinds Co., Syracuse 10.

Terms Expire 1950

A. S. Bowen, Goulds Pumps Inc., Seneca Falls.
E. E. Hook, Dayton Oil Co., Syracuse.
J. Francis Dobbs, New York Air Brake Co., Watertown.

Central Ohio Chapter

(Established 1945)

Chairman—R. H. Frank, Chief Met., Bonney-Floyd Co., Columbus, Ohio.
Vice-Chairman—F. W. Fuller, Field Engr., National Engineering Co., Columbus.
Secretary—D. E. Krause, Res. Engr., Battelle Memorial Institute, Columbus.
Treasurer—Wm. R. Huffman, Plant Mgr., H. B. Salter Mfg. Co., Marysville.
Directors—Terms Expire 1948

Wm. T. Bland, Supt., Commercial Steel Casting Co., Marion.
N. J. Dunbeck, Vice-Pres., Eastern Clay Products, Inc., Jackson.
Harry Warsmith, Fdry. Mgr., Jeffrey Mfg. Co., Columbus.
Karol Whitlatch, 439 N. Richardson Ave., Columbus 4.
D. M. Whyte, Mt. Vernon.
J. J. Witenhafer, Mgr., Columbus Malleable Iron Co., Columbus 3.

Terms Expire 1949

W. L. Deutsch, Sales Engr., Columbus Malleable Iron Co., Columbus 3.
R. E. Fisher, Sr., Pres., Bonney Floyd Co., Columbus.

Chesapeake Chapter

(Established 1940)

Chairman—Wm. H. Holtz, American Brake Shoe Co., Baltimore 17, Md.
Vice-Chairman—Blake M. Loring, Head, Non-Fer. Sec., Naval Research Laboratory, Bellevue, Washington, D.C.
Secretary-Treasurer—L. H. Denton, Baltimore Convention Bureau, Baltimore 2, Md.
Technical-Secretary—Wm. H. Baer, Assoc. Met., Naval Research Laboratory, Bellevue, Washington, D.C.
Directors—Terms Expire 1948

H. A. Horner, Met., Frick Co., Waynesboro, Pa.
J. B. Mentzer, Secy-Treas., Wood-Embly Brass Co., Waynesboro, Pa.
G. L. Webster, Baltimore Polytechnic Institute, Baltimore, Md.

Terms Expire 1949

A. A. Hochrein, Dist. Mgr., Federated Metals Div., American Smelting & Refining Co., Baltimore 24, Md.
James J. Lacy, Pres., James J. Lacy Co., Baltimore 31, Md.
C. A. Robeck, Vice-Pres. & Supt., Gibson & Kirk Co., Baltimore, Md.

Terms Expire 1950

L. Earl Gaffney, Vice-Pres., Arlington Bronze & Aluminum Corp., Baltimore 15, Md.
J. Arthur Reese, Fdry. Met., American Hammered Piston Ring Div., Koppers Co., Inc., Baltimore 3, Md.
David Tamor, Plant Met., American Chain & Cable Co., York, Pa.

Chicago Chapter

(Established 1934)

President—F. B. Skeates, Fdry. Supt., Link-Belt Co., Chicago.
Vice-President—Chester K. Faunt, Christensen & Olsen Fdry Co., Chicago.
Secretary—V. M. Rowell, Tech. Sales Rep., Velsicol Corp., Chicago.
Treasurer—Bruce L. Simpson, Pres., National Engineering Co., Chicago 6.
Directors—Terms Expire 1948

Oscar Blohm, Co-Owner, Triangle Foundry Co., Chicago 41.
Arthur S. Klopf, Works Engr., Western Foundry Co., Chicago.
C. G. Mate, Supt., Greenlee Foundry Co., Chicago.
A. K. Sanderson, Vice-Pres. & Mgr., Love Bros., Inc., Aurora.

Terms Expire 1949

J. C. Gore, Mgr., Werner G. Smith Co., Chicago.
D. H. Lucas, Mfgrs. Repr., 6441 N. Seeley Ave., Chicago 45.
H. K. Swanson, Owner, Swanson Pattern & Model Works, East Chicago, Ind.
Chester V. Nass, Vice-Pres. & Mgr. Fdry. Div., Pettibone Mulliken Corp., Chicago 51.

Terms Expire 1950

Geo. W. Anselman, Serv. Engr., Goebig Mineral Supply Co., Chicago.
W. B. George, Fdry. Engr., R. Lavin & Sons, Inc., Chicago.
R. M. Jones, Supt. of Fdries., Carnegie Illinois Steel Corp., Chicago.
Laurence H. Hahn, Met. Superv., Sivyer Steel Casting Co., Chicago.

Cincinnati District Chapter

(Established 1939)

Chairman—Edgar J. Kihn, Gen. Fore., Cincinnati Milling Machine Co., Cincinnati, Ohio.

Vice-Chairman—Alexander D. Barczak, Vice-Pres., Bardes Forge & Foundry Co., Cincinnati 13, Ohio.

Secretary—Earl F. Kindinger, Fdry. Engr., Williams & Co., Inc., Cincinnati, Ohio.

Treasurer—Chas. S. Dold, Asst. Mgr. Coke Sales, Portsmouth Steel Corp., Cincinnati 2, Ohio.

Assistant-Treasurer—Walter A. Funck, Gen. Supt., The Reliance Foundry Co., Cincinnati, Ohio.

Directors—Terms Expire 1948

Emil Albrecht, Pres., Aluminum Foundry, Cincinnati, Ohio.

Alfred Schneble, Jr., Plt. Mgr., Advance Foundry Co., Dayton 3, Ohio.

Chas. D. Steinmeier, Fdry Supt., A. D. Cook, Inc., Lawrenceburg, Ind.

Terms Expire 1949

Geo. A. Avril, G. A. Avril Smelting Works, Cincinnati, Ohio.

C. H. Fredricks, Cincinnati Milling Machine Co., Cincinnati 7, Ohio.

Paul Ziegler, Gen. Mgr., H. P. Deuscher Co., Hamilton, Ohio.

Terms Expire 1950

J. D. Judge, Works Engr., Hamilton Foundry & Machine Co., Hamilton, Ohio.

Arthur L. Grim, Supt. of Fdry. The Dayton Malleable Iron Co., Dayton 1, Ohio.

Walter J. Klayer Aluminum Industries, Inc., Cincinnati, Ohio.

Detroit Chapter

(Established 1935)

Chairman—Wm. W. Bowring, Frederic B. Stevens, Inc., Detroit 26.

Vice-Chairman—A. W. Stolzenburg, Aluminum Co. of America, Detroit 11.

Secretary—Robert E. Cleland, Salesman, Eastern Clay Products, Inc., Detroit 26.

Treasurer—George A. Fuller, Jr., Branch Mgr., Federal Foundry Supply Co., Detroit 16.

Directors—Terms Expire 1948

R. G. McElwee, Mgr., Iron Foundry Div., Vanadium Corp. of America, Detroit.

Gosta Vennerholm, Met., Ford Motor Co., Dearborn, Mich.

R. J. Wilcox, Chief Met., Michigan Steel Castings Co., Detroit 7.

J. P. Carritte, Pres., True Alloys, Inc., Detroit 9.

Terms Expire 1949

Pierce Boutin, Supt., Pontiac Motor Div., General Motors Corp., Pontiac, Mich.

J. E. Coon, Prod. Met. Fdry. Dept., Packard Motor Car Co., Detroit.

R. L. Orth, Sales Engr., American Wheelabrator & Equip. Corp., Detroit 2.

W. N. Seese, Serv. Engr., J. S. McCormick Co., Detroit.

Terms Expire 1950

Elmer J. Heiden, Riley Stoker Corp., Detroit.

E. J. Rousseau, Pres., Commerce Pattern Foundry & Machine Co., Detroit 17.

Claude B. Schneible, Pres., Claude B. Schneible Co., Detroit 16.

E. H. Stilwill, Met., Chrysler Corp., Dodge Div., Detroit.

Eastern Canada and Newfoundland Chapter

(Established 1942)

Chairman—A. E. Cartwright, Met., Crane Ltd., Montreal, Quebec.

Vice-Chairman—O. Lawrence Voisard, Gen. Supt., The Robert Mitchell Co., Ltd., Montreal, Quebec.

Secretary—John G. Hunt, Met. Dept., Dominion Engineering Works, Ltd., Montreal, Quebec.

Treasurer—L. Guilmette, Treas., Canadian Foundry Supplies & Equip. Co., Ltd., Montreal, Quebec.

Directors—Terms Expire 1948

Delvica Allard, 233 Querbes Ave., Outremont, Montreal, Quebec.

H. E. Francis, Jenkins Bros. Ltd., Montreal, Quebec.

Edw. Laurendeau, Partner, Canadian Pattern & Woodworking Co., Montreal, Quebec.

James H. Newman, Mgr., Newman Foundry Supply Ltd., Montreal, Quebec.

O. H. Seveigny, Gen. Mgr., Lynn MacLeod Metallurgy Ltd., Thetford Mines, Quebec.

Terms Expire 1949

Wm. L. Bond, Fdry. Mgr., Ottawa Car & Aircraft, Ltd., Ottawa, Ontario.

C. C. Brisbois, Montreal, Quebec.

W. J. Brown Robert W. Bartram, Ltd., Montreal, Quebec.

W. M. Hamilton, Gen. Supt., Crane Ltd., Montreal, Quebec.

John Shewan, Fdry. Supt., Canadian Car & Foundry Co., Ltd., Lachine, Quebec.

Terms Expire 1950

Rene Belisle, Works Mgr., J. A. Gosselin, Ltd., Drummondville, Quebec.

W. E. Hillis, Vice Pres. & Fdry. Mgr., Hillis & Sons, Ltd., Halifax, N.S.

James Grieve, Fdry. Supt., Dominion Engineering Works, Ltd., Lachine, Quebec.

M. A. Hughes, Indus. Slsm., LaSalle Coke Co., Montreal, Quebec.

W. Turney Shute, Canadian Car & Foundry Co., Ltd., Montreal, Quebec.

Metropolitan Chapter

(Established 1938)

Chairman—Kenneth A. DeLonge, Development & Res. Div., International Nickel Co., Inc., New York.

Vice-Chairman—John A. Bukowski, Works Met., Worthington Pump & Machinery Corp., Harrison, N.J.

Secretary—J. Fred Bauer, Salesman, Hickman, Williams & Co., New York.

Treasurer—D. Polderman, Jr., Vice-Pres. & Export Mgr., Whiting Corp., New York.

Directors—Terms Expire 1948

Harold L. Ullrich, Sacks-Barlow Foundries, Inc., Newark 5, N.J.

D. Frank O'Connor, Fdry. Supt., American Saw Mill Machinery Co., Hackettstown, N.J.

B. E. Beldin, Whitehead Bros. Co., New York.

B. N. Ames, Jr., Met., U. S. Navy Yard, Materials Lab., Brooklyn.

Philip R. Van Duyne, Pres., The Meeker Foundry Co., Newark, N.J.

Arthur L. Fischer, Gen. Mgr., Fischer Casting Co., N. Plainfield, N.J.

Terms Expire 1949

D. W. Talbot, Gen. Mgr., Cooper Alloy Foundry Co., Hillside, N.J.

Williams F. Rose, Repr., Smith Oil & Refining Co., Ramsey, N.J.

R. D. Speirs, Pattern Supt., Wright Aeronautical Corp., Woodridge, N.J.

R. A. Flinn, Jr., Met., American Brake Shoe Co., Mahwah, N.J.

J. S. Vanick, Met., International Nickel Co., Inc., New York 5.

Mexico City Chapter

(Established 1945)

President—Ing. Manuel Goicochea Gen. Mgr., Fundiciones de Hierro y Acero S.A., Prolongacion Calle Diez No. 145, San Pedro de los Pinos, Mexico, D.F.

Vice-President—Ing. Ernesto Macias Sauza, Gen. Mgr., Fundiciones y Talleres America, S.A., Mariana Escobedo 218, Mexico, D.F.

Secretary—N. S. Covacevich, Owner, N. S. Covacevich Foundry Supplies, Reforma No. 12, Apto. Postal 1030, Mexico, D.F.

Treasurer—Fernando Gonzalez Vargas, Sr. Ing. Quimico, 2a Privada C. Beistegui No. 14, Col. Valle, Mexico, D.F.

Directors

Ing. Secundino Ruiz, Dinamorca N-77—Dept. 5, Mexico, D.F.

David E. Stine, Gen. Fdry. Supt., La Consolidada, S.A., Calzada de la Rondo No. 88, Mexico, D.F.

Alfredo Cruz G., Fundicion Sabino, Prolongacion Calle Sabino No. 3095 y calle 5, Mexico D.F.

Michiana Chapter
(Established 1940)

Chairman—H. B. Voorhees, Works Mgr., Peru Foundry Co., Peru, Ind.

Vice-Chairman—K. A. Nelson, Branch Mgr., Chicago Hardware Foundry Co., Elkhart, Ind.

Secretary-Treasurer—V. S. Spears, Sales Engr., American Wheelabrator & Equipment Corp., Mishawaka, Ind.

Directors—Terms Expire 1948

James E. Digan, Logansport Foundry Industries, Inc., Logansport, Ind.

G. O. McCray, Bendix Products Div., Bendix Aviation Corp., South Bend, Ind.

John Rush, Supt., Elkhart Brass Mfg. Co., Elkhart, Ind.

M. F. Surls, Met., Clark Equipment Co., Western Springs, Ill.

Terms Expire 1949

Wm. Ferrell, Gen. Works Supt., Auto Specialties Mfg. Co., St. Joseph, Mich.

George Garvey, Patt. Fore., City Pattern & Foundry Co., Inc., South Bend, Ind.

Stanley F. Krzeszewski, Fact. Mgr., American Wheelabrator & Equip. Corp., Mishawaka, Ind.

I. S. Peterson, Works Mgr., Premier Furnace Co., Dowagiac, Mich.

Terms Expire 1950

A. J. Edgar, Works Mgr., Benton Harbor Malleable Industries, Inc., Benton Harbor, Mich.

W. J. Freyer, Weil-McLain Co., Michigan City, Ind.

Wm. F. Lange, Jr., Vice-Pres., Casting Service Corp., La Porte, Ind.

F. T. McGuire, Met., Sibley Machine & Foundry Corp., South Bend, Ind.

Northeastern Ohio Chapter
(Established 1935)

President—H. C. Gollmar, Gen. Mgr., Elyria Foundry Div., Industrial Brownhoist Corp., Elyria, Ohio.

Vice-President—E. C. Zirzow, Core Rm. Fore., National Malleable & Steel Castings Co., Cleveland.

Secretary—R. D. Walter, Chem., Werner G. Smith Co., Cleveland.

Treasurer—F. Ray Fleig, President, Smith Facing & Supply Co., Cleveland 13.

Directors—Terms Expire 1948

Frank C. Cech, Teacher, Cleveland Trade School, Cleveland.

David Clark, Asst. Plant Mgr., Forest City Foundries Co., Cleveland.

Edw. J. Metzger, Plant Mgr., Wellman Bronze & Aluminum Co., Cleveland 6.

Leon F. Miller, Sales, Osborn Mfg. Co., Cleveland 14.

Thos. D. West, Vice-Pres., West Steel Casting Co., Cleveland 8.

Terms Expire 1949

C. S. Winter, Pres., Duplex Mfg. & Foundry Co., Elyria, Ohio.

Wm. G. Gude, Mng. Editor, *The Foundry*, Cleveland 13.

Fred J. Pfarr, Plant Mgr., Lake City Malleable Co., Cleveland.

Vincent J. Sedlon, Owner, Mastern Pattern Co., Cleveland 13.

Walter E. Sicha, Met., Aluminum Co. of America, Cleveland 5.

Terms Expire 1950

G. M. Cover, Prof. Dept. of Met. Engrg., Case Institute of Technology, Cleveland.

E. G. Fahlman, Pres., The Permold Co., Medina, Ohio.

Gilbert J. Nock, Vice-Pres., The Nock Fire Brick Co., Cleveland 14.

John Schneider, Industrial Sales Dept., The Cleveland Electric Illuminating Co., Cleveland.

John M. Urban, Fdry. Supt., The Fanner Mfg. Co., Cleveland.

Northern California Chapter
(Established 1935)

President—A. M. Ondreyco, Works Mgr., Vulcan Foundry Co., Oakland.

Vice-President—George McDonald, Production Mgr., H. C. Macaulay Foundry Co., Berkeley.

Secretary—J. F. Aicher, Dist. Mgr., E. A. Wilcox Co., San Francisco.

Co-Secretary—Charles R. Marshall, Dist. Mgr., Chamberlain Co.

Directors—Terms Expire 1948

Leon Cameto, Owner, Production Foundry Co., Oakland.

Wm. W. Clark, Met., Enterprise Engine & Foundry Co., San Francisco.

H. M. Donaldson, Partner, Brumley-Donaldson Co., San Francisco.

Fred T. Williams, Vice-Pres., Empire Foundry Co., Inc., Oakland 7.

Terms Expire 1949

William Butts, Gen. Mgr., General Metals Corp., Oakland.

Roy C. Wendelbo, Management Supt., De Sanno Foundry & Machine Co., Oakland.

John R. Russo, Vice-Pres., General Foundry Service Corp., Oakland.

H. Milton Nystrom, Sales Mgr., Vulcan Steel Foundry Co., Oakland.

Northern Illinois-Southern Wisconsin Chapter
(Established 1938)

Chairman—John T. Clausen, Fdry. Engr., Greenlee Bros. & Co., Rockford, Ill.

Vice-Chairman—H. J. Bauman, Fdry. Supt., Ebaloy Foundries, Inc., Rockford, Ill.

Secretary—Lester C. Fill, Fdry. Supt., Geo. D. Roper Corp., Rockford, Ill.

Treasurer—John N. Johnson, Asst. Works Mgr., J. I. Case Co., Inc., Rockford, Ill.

Directors—Terms Expire 1948

O. W. Josephson, Sales Repr., S. Obermayer & Co., Rockford.

Gunnard Johnson, Met., Beloit Iron Works, Beloit, Wis.

R. W. Mattison, Vice-Pres., Mattison Machine Works, Rockford, Ill.

Terms Expire 1949

John A. Forbes, Exec. Vice-Pres., Gunite Foundries Corp., Rockford, Ill.

John R. Cochran, Fdry. Fore., J. I. Case Co., Inc., Rockford, Ill.

Leon S. Hull, Fdry. Fore., Beloit Foundry Co., Beloit, Wis.

Terms Expire 1950

Bruce Whiting, Chief Engr., Woodmanse Mfg. Co., Freeport.

Jack Rundquist, Co-Owner, Beloit Casting Co., Beloit, Wis.

F. W. Thayer, Asst. Works Mgr., Gunite Foundries Corp., Rockford, Ill.

Northwestern Pennsylvania Chapter
(Established 1945)

Chairman—John W. Clarke, Asst. Supt. of Fdries., General Electric Co., Erie.

Vice-Chairman—J. S. Hornstein, Secy., Meadville Malleable Iron Co., Meadville.

Secretary—H. L. Gebhardt, Pres., United Oil Mfg. Co., Erie.

Treasurer—Jos. A. Shuffstall, Plant Mgr., National-Erie Corp., Erie.

Directors—Terms Expire 1948

Fred J. Eisert, Partner, Urick Foundry Co., Erie.

T. H. Beaulac, Fdry. Supt., Chicago Pneumatic Tool Co., Franklin.

Clarence H. Fitz, Fdry. Supt., Hays Mfg. Co., Erie.

Earl M. Strick, Finish. Supt., Erie Malleable Iron Co., Erie.

Terms Expire 1949

John E. Gill, Supt., Lake Shore Pattern Works, Erie.

George Johnstone, Jr., Pres. & Gen. Mgr., Johnstone Foundries, Inc., Grove City.

J. Douglas James, Cooper Bessemer Corp., Grove City.

Terms Expire 1950

Bailey D. Herrington, Serv. Tech., Hickman, Williams & Co.

James J. Farina, Fdry. Supt., American Sterilizer Co., Erie.

Frank P. Volgstadt, Fdry. Supt., Griswold Mfg. Co., Erie.

Ontario Chapter
(Established 1938)

Chairman—J. Dalby, Mgr., Wilson Brass & Aluminum Fdries., Toronto.

Vice-Chairman—R. A. Woods, Mgr., Geo. F. Pettinos, Ltd., Hamilton.

Secretary-Treasurer—G. L. White, Editorial Dir., Westman Publications, Ltd., Toronto.
Directors—Terms Expire 1948
E. G. Storie, Plant Supt., Fittings, Ltd., Oshawa.
J. H. King, Salesman, Werner G. Smith, Ltd., Toronto.
H. E. Craddock, Supt., Beatty Bros. Ltd., London.
D. H. Gilbert, Plant Mgr., Dominion Wheel & Foundries, Ltd., St. Boniface, Manitoba.
Terms Expire 1949
M. N. Tallman, Met., A. H. Tallman Bronze Co., Ltd., Hamilton.
C. O. Flowers, Supt., Canada Iron Foundries, Ltd., Hamilton.
Alvin E. Bock, Production Castings, Ltd., New Toronto.
Terms Expire 1950
Neil Kennedy, The William Kennedy & Sons, Ltd., Owen Sound.
R. T. Wilson, Asst. Plant Supt., Ontario Malleable Iron Co., Ltd., Oshawa.
Reginald Williams, Supt. of Fdries., Canadian Westinghouse Co., Ltd., Hamilton.

Oregon Chapter
(Established 1945)

Chairman—A. R. Prier, Mgr., Oregon Brass Works, Portland.
Vice-Chairman—J. Otis Grant, Electric Steel Fdry. Co., Portland.
Secretary-Treasurer—A. B. Holmes, Supt., Crawford & Doherty Foundry Co., Portland.
Directors—Terms Expire 1948
S. E. Peeler, Supt., Electric Steel Foundry Co., Portland.
W. R. Pindell, Mgr., Northwest Foundry & Furnace Co., Portland 2.
A. R. Prier, Mgr., Oregon Brass Works, Inc., Portland 14.
Terms Expire 1949
A. B. Holmes, Supt., Crawford & Doherty Foundry Co.
H. L. Tatham, Supt., Pacific Steel Foundry Co., Portland 10.
L. E. Bufton, Partner, Silica Products of Oregon, Portland.
Terms Expire 1950
J. Otis Grant, Electric Steel Foundry Co., Portland 2.
Lee E. Holcomb, Asst. to Supt., Crawford & Doherty Foundry.
Harry K. McAllister, Patt. Shop Frm., Western Foundry Co., Portland.

Philadelphia Chapter
(Established 1935)

Chairman—E. C. Troy, Vice-Pres., Dodge Steel Co., Philadelphia.
Vice-Chairman—C. L. Lane, Met., Florence Pipe Foundry & Machine Co., Florence, N.J.
Secretary-Treasurer—W. B. Coleman, Pres., W. B. Coleman & Co., Philadelphia 40.
Directors—Terms Expire 1948
B. A. Miller, Supt. Fdries., Cramp Brass & Iron Fdries. Div., Baldwin Locomotive Works, Philadelphia.
H. E. Mandel, Vice-Pres., Pennsylvania Foundry Supply & Sand Co., Philadelphia 24.
Earl Eastburn, Fdry. Supt., Phosphor Bronze Smelting Co., Philadelphia 46.
Terms Expire 1949
William Morley, Fdry. Mgr., Olney Foundry Div., Link-Belt Co., Philadelphia 20.
A. C. Gocher, Fdry. Supt., Fletcher Works, Inc., Philadelphia.
Terms Expire 1950
C. B. Jenni, Met., General Steel Castings Corp., Philadelphia.
W. B. Wilkins, Pres. & Gen. Mgr., American Manganese Bronze Co., Philadelphia.

Quad City Chapter
(Established 1935)

Chairman—R. H. Swartz, Gen. Mgr., Riverside Foundry, S & W Foundry Corp., Bettendorf, Iowa.
Vice-Chairman—M. H. Liedtke, Fdry. Supt., International Harvester Co., Moline, Ill.
Secretary-Treasurer—C. R. Marthens, Owner, Marthens Co., Moline, Ill.
Directors—Terms Expire 1948
C. S. Humphrey, C. S. Humphrey Co., Moline, Ill.
R. E. Wilke, Met., Deere & Co., Moline, Ill.
Jack O. Nelsen, Supt., Mississippi Foundry Corp., Rock Island, Ill.
E. P. Closen, Gen. Fdry. Frm., Deere & Mansur Wks., Deere & Co., Moline, Ill.
Terms Expire 1949
A. D. Matheson, Works Mgr., French & Hecht, Inc., Davenport, Iowa.
Carl Von Luhrte, Western Sales Mgr., Chicago Retort & Fire Brick Co., Chicago.
A. H. Putnam, A. H. Putnam Co., Rock Island, Ill.
Terms Expire 1950
Wm. C. Bell, Prod. Engr., Frank Foundries Corp., Moline, Ill.
H. L. Mead, John Deere Harvester Works, East Moline, Ill.
H. A. Rasmussen, Pres., Ferro-Bronze Corp., Moline, Ill.

Rochester Chapter
(Established 1944)

President—L. C. Gleason, Fdry. Supt., Gleason Works, Rochester, N.Y.
Vice-President—Max T. Ganzauge, General Railway Signal Co., Rochester, N.Y.
Secretary-Treasurer—Leon C. Kimpal, Rochester Gas & Electric Corp., Rochester, N.Y.
Directors—Terms Expire 1948
Neal F. Clement, Vice-Pres., Rochester-Erie Foundry Corp., Rochester, N.Y.
David Baxter, Agt., Sterling Wheelbarrow Co., Rochester, N.Y.
Donald Webster, Met., American Laundry Machinery Co., Rochester, N.Y.
Walter Brayer, Fdry. Supt., Bausch & Lomb Optical Co., Rochester, N.Y.
Terms Expire 1949
Herman Hetzler, Pres., Hetzler Foundries, Inc., Rochester, N.Y.
Carl Johnson, Asst. to Wks. Mgr., Symington-Gould Corp., Rochester, N.Y.
Jack Steeves, Partner, Corbett-Steeves Pattern Works, Rochester 6, N.Y.
Terms Expire 1950
Fred E. Adsit, Patt. Frm., Ingersoll-Rand Co., Painted Post, N.Y.
Dr. Robert Raudebaugh, Asst. Prof. of Met. Eng., University of Rochester, Rochester 3, N.Y.

Saginaw Valley Chapter
(Established 1945)

Chairman—Marshall V. Chamberlin, Met., Dow Chemical Co., Bay City, Mich.
Vice-Chairman—O. E. Sundstedt, Vice-Pres. & Gen. Mgr., General Foundry & Mfg. Co., Flint, Mich.
Secretary-Treasurer—L. L. Clark, Asst. Fdry. Met., Buick Motor Div., General Motors Corp., Flint, Mich.
Directors—Terms Expire 1948
E. H. Bankard, Asst. Supt., Buick Motor Div., General Motors Corp., Flint, Mich.
J. E. Bowen, Chief Met., Chevrolet-Saginaw Grey Iron Foundry, Saginaw, Mich.
M. C. Godwin, Bostick Foundry Co., Lapeer, Mich.
K. H. Priestley, Pres., Vassar Electroloy Products, Vassar, Michigan.
A. H. Karpicke, Jr., Met., Central Foundry Div., General Motors Corp., Saginaw, Mich.
John F. Smith, Gen. Supt. Prod., Chevrolet-Saginaw Grey Iron Foundry, Saginaw, Mich.
Terms Expire 1949
D. D. Bowman, Off. Mgr., Almont Manufacturing Company, Almont, Mich.
L. A. Cline, Secy., Saginaw Foundries Co., Saginaw, Mich.
Terms Expire 1950
C. A. Tobias Head, Science Dept., General Motors Institute, Flint, Mich.
Howard H. Wilder, Chief Met., Eaton Manufacturing Company, Vassar, Mich.

St. Louis District Chapter
(Established 1935)

Chairman—Norman L. Peukert, Carondelet Foundry Co., St. Louis.
Vice-Chairman—Albert L. Hunt, Plant Supt., National Bearing Div., American Brake Shoe Co., St. Louis.
Secretary—Paul E. Retzlaff, Fdry. Mgr., Busch-Sulzer Bros.-Diesel Engrg. Co., Div. Nordberg Mfg. Co., St. Louis 18.
Treasurer—Henry W. Meyer, General Steel Castings Co., St. Louis.
Directors—Terms Expire 1948
J. R. Bodine, Pres., Bodine Pattern & Foundry Co., St. Louis.
Herman Weible, Fdry. Supt., Maco Foundry & Enamel Shop, St. Louis.
Ralph M. Hill, Jr., Treas. & Supt., East St. Louis Casting Co., East St. Louis, Ill.
Walter Zeis, Walter Zeis Co., Webster Groves 19, Mo.
Terms Expire 1949
Walter E. Illig, Vice-Pres., Banner Iron Works, St. Louis 10.
Charles Rothweiler, Salesman, Hickman, Williams & Co., St. Louis.
E. J. Aubuchon, Pres., M. A. Bell Co., St. Louis.
Albert S. Hard, Supt., St. Louis Steel Casting Co., St. Louis.
Terms Expire 1950
Roland T. Leisk, Asst. Works Mgr., American Steel Foundries, East St. Louis, Ill.
Robert E. Woods, Treas., Warren Coke Co., St. Louis 1.
F. W. Burgdorfer, Pres., Missouri Pattern Co., St. Louis.
George Shepherd, Supt., Duncan Fdry. & Machine Works, Inc., Alton, Ill.

Southern California Chapter
(Established 1937)

President—H. E. Russill, Eld Metal Co., Ltd., Los Angeles 1.
Vice-President—L. O. Hofstetter, Brumley-Donaldson Co., Los Angeles 11.
Secretary—John E. Wilson, Met. Engr., Climax Molybdenum Co., Los Angeles 14.
Treasurer—Earle D. Shomaker, Kay-Brunner Steel Products Co., Alhambra.
Directors—Terms Expire 1948
James B. Morey, Met., International Nickel Co., Inc., Los Angeles.
L. M. Nash, Magnesium Alloy Products Co., Compton.
Edw. K. Smith, Beverly Hills.
Wm. D. Emmett, Los Angeles Steel Casting Co., Ltd., Los Angeles.
Terms Expire 1949
A. L. Goodreau, Vice-Pres. & Gen. Mgr., G. B. Brass & Aluminum Foundry, Los Angeles 11.
Myron B. Niesley, California Testing Labs., Inc., Los Angeles 21.
C. E. Holmer, Kinney Iron Works, Los Angeles.
Arthur B. Lamb, Independent Foundry Supply Co., Los Angeles.

Texas Chapter
(Established 1943)

Chairman—Marvin W. Williams, Fdry. Mgr., Hughes Tool Co.
Vice-Chairman—Jake Dee, Owner, Dee Brass Foundry, Houston 9.
Secretary-Treasurer—Harry L. Wren, Sales Rep., Houston 2.
Directors—Terms Expire 1948
W. C. Fleming, Fdry. Supt., Hughes Tool Co., Houston 1.
Owen Murphy, Partner, Star Foundry Co., Houston 1.
J. O. Klein, Vice-Pres., Texas Foundries, Inc., Lufkin.
Arthur H. Stenzel, Owner, Stenzel Pattern Works, Houston 14.
Terms Expire 1949
George E. Bryant, Jr., Pres., Oil City Brass Wks., Beaumont.
L. N. Crim, East Texas Electric Steel Co., Longview.
R. H. Glenney, Fdry. Engr., Alamo Iron Works, San Antonio.
DeWitt McKinley, Mgr., McKinley Iron Works, Fort Worth.
Terms Expire 1950
Chas. R. McGrail, Pres., Texaloy Foundry Co., San Antonio.
Joseph A. Wolf, Wolf Pattern Works, Houston.
H. L. Roberts, Vice-Pres., Oil City Iron Works, Corsicana.
C. W. Williamson, Vice-Pres., Trinity Valley Iron & Steel Co., Fort Worth.

Timberline Chapter
(Established 1947)

Chairman—J. L. Higson, Partner, Western Foundry, Denver 5, Colo.
Vice-Chairman—Shelby C. Cook, Sr., Sec.-Treas., U. S. Foundries, Inc., Denver 4, Colo.
Secretary—Chas. E. Stull, Pres., Manufacturers Foundry Corp., Denver, Colo.
Treasurer—John W. Horner, Jr., Slack-Horner Brass Mfg. Co., Denver 11, Colo.
Directors—Terms Expire 1950
E. B. McPherson, Pres., McPherson Corp., Denver, Colo.
Edw. B. Zabriskie, Plant Mgr., Magnus Metals Div., National Lead Co., Denver 5, Colo.
Pearson M. Payne, Mgr., Rotary Steel Castings Co., Denver, Colo.
C. O. Penney, C. S. Card Iron Works Co., Denver, Colo.

Toledo Chapter
(Established 1941)

Chairman—Gerald R. Rusk, Sales Rep., Freeman Supply Co., Toledo, Ohio.
Vice-Chairman—Emmett E. Thompson, Patt. Supt., Unitcast Corp., Toledo, Ohio.
Secretary-Treasurer—Rudy Van Hellen, Unitcast Corp., Toledo.
Directors—Terms Expire 1948
Floyd E. Ensign, Pres., Multi-Cast Corp., Wauseon, Ohio.
Leighton M. Long, Leighton M. Long & Associates, Toledo.
W. P. Mack, Bruce Foundry & Mfg. Co., Tecumseh, Mich.
Terms Expire 1949
A. V. Fromm, Supt., American Brake Shoe Co., Toledo, Ohio.
N. P. Mahoney, Supt., Maumee Malleable Castings Co., Toledo.
Harry G. Schwab, Chief Met., Bunting Brass & Bronze Co., Toledo, Ohio.
Terms Expire 1950
Frank W. Beierla, Pres., Clinton Pattern Works, Toledo, Ohio.
Jay Moon, Freeman Supply Co., Toledo, Ohio.
Brock L. Pickett, Chief Insp., Unitcast Corp., Toledo, Ohio.

Tri-State Chapter
(Established 1947)

Chairman—R. W. Trimble, Fdry. Supt., Bethlehem Supply Co., Tulsa, Okla.
Vice-Chairman—Dale Hall, Met., Oklahoma Steel Castings Co., Tulsa, Okla.
Secretary—Clyde B. Fisher, Plant Engr., Enardo Foundry & Mfg. Co., Tulsa, Okla.
Treasurer—Frank G. Lister, Sales Repr., Chicago Pneumatic Tool Co., Tulsa, Okla.
Directors—Terms Expire 1948
E. C. Graham, Mgr., Acme Foundry & Machine Co., Blackwell, Okla.
C. H. Bentley, Pres., The Webb Corp., Webb City, Mo.
Terms Expire 1949
Fred E. Fogg, Sales Repr., Acme Foundry & Machine Co., Coffeyville, Kan.
Morris C. Helander, Plant Mgr., Enardo Foundry & Mfg. Co., Tulsa, Okla.
Terms Expire 1950
B. P. Glover, Salesman, M. A. Bell Co., Tulsa, Okla.
Frank R. Westwood, Jr., Brass Foundry Fore., Service Foundry Co., Wichita, Kan.

Twin City Chapter
(Established 1941)

Chairman—Sheldon P. Pufahl, Pufahl Foundry, Inc., Minneapolis, Minn.
Vice-Chairman—I. F. Cheney, Supt., Griffin Wheel Co., St. Paul, Minn.
Secretary-Treasurer—Lillian K. Polzin, Director, Manufacturers'

Secretariat, Minneapolis Chamber of Commerce, Minneapolis 2, Minn.

Directors—Terms Expire 1948

H. M. Patton, Fdry. Supt., American Hoist & Derrick Co., St. Paul 1, Minn.

A. M. Fulton, Vice-Pres., Northern Malleable Iron Co., St. Paul 6, Minn.

Clifford Englund, Vice-Pres., Central Machine Works Co., Minneapolis, Minn.

H. J. Bierman, Owner, Acme Foundry Co., Minneapolis 6, Minn.

Terms Expire 1949

Robert C. Wood, Vice Pres., Minneapolis Electric Steel Castings Co., Minneapolis 13, Minn.

Carleton C. Hitchcock, Partner, R. C. Hitchcock & Sons, Minneapolis 6, Minn.

E. R. Frost, Pres., The E. R. Frost Co., Minneapolis 14, Minn.

Terms Expire 1950

Franklin A. Austin, Vice-Pres., Crown Iron Works Co., Minneapolis, Minn.

Clarence J. Becker, Treas.-Vice-Pres., Union Brass & Metal Mfg. Co., St. Paul, Minn.

Francis J. Marrin, Pres., Marrin Foundry, Inc., Minneapolis, Minn.

Washington Chapter

(Established 1946)

Chairman—C. M. Anderson, Vice-Pres., Eagle Brass Foundry Co., Seattle.

Vice-Chairman—Geo. E. Rauen, Met., Olympic Foundry Co., Seattle 8.

Secretary-Treasurer—A. D. Cummings, Sales Engr., Western Foundry Sand Co., Seattle 99.

Directors

James D. Tracy, Treas., Salmon Bay Foundry, Seattle 5.

Vernon Creten, Asst. Supt., Atlas Foundry & Machine Co., Tacoma.

C. W. Summerville, Vice-Pres., Seattle Brass Co., Seattle.

E. D. Boyle, Master Molder, X81 Foundry, U. S. Navy Yard, Bremerton.

G. S. Schaller, Prof. Mech. Engrg., University of Washington, Seattle.

Howard Heath, Fdry. Supt., Sumner Iron Works, Everett, Wash.

Western Michigan Chapter

(Established 1941)

Chairman—Chas. H. Cousineau, West Michigan Steel Foundry Co., Muskegon.

Vice-Chairman—W. A. Hallberg, Fdry. Engr., Lakey Foundry & Mach. Co., Inc., Muskegon.

Secretary—Donald A. Paull, Chief Met., Sealed Power Corp., Muskegon.

Treasurer—Chas. N. Jacobsen, Prod. Mgr., Dake Engine Co., Grand Haven.

Directors—Terms Expire 1948

W. R. Krepps, Plant Mgr., Campbell, Wyant & Cannon Fdry. Co., Muskegon.

A. G. Raddatz, Vice-Pres., Lakeshore Machinery & Supply Co., Muskegon.

William R. Tuthill, Supt. Iron Div., American Seating Co., Grand Rapids.

R. F. Flora, Met., Clover Foundry Co., Muskegon.

Terms Expire 1949

Otto H. Frank, Qual. Res. Engr., Muskegon Piston Ring Co., Sparta.

Fred H. Papke, Fdry. Supt., Wolverine Brass Works, Grand Rapids.

Wm. Grant, Vice-Pres., Paul M. Wiener Foundry Co., Muskegon.

Terms Expire 1950

Robert DeVore, Lakey Foundry & Machine Co., Inc., Muskegon.

Victor Pyle, Pyle Pattern & Mfg. Co., Muskegon Hgts., Mich.

Harold BeMent, Chief Met., Campbell, Wyant & Cannon Foundry Co., Muskegon.

Western New York Chapter

(Established 1941)

Chairman—Elliott R. Jones, Plant Supt., Lumen Bearing Co., Buffalo.

Vice-Chairman—Martin J. O'Brien, Jr., Asst. Works Mgr., Symington Gould Corp., Lancaster.

Secretary—Fred L. Weaver, Owner, Weaver Material Service, Buffalo 7.

Treasurer—Martin W. Pohlman, Vice-Pres., Pohlman Foundry Co., Inc., Buffalo.

Directors—Terms Expire 1948

Henry C. Winte, Met., Worthington Pump & Machinery Corp., Buffalo.

John C. Goetz, Fdry Supt., Acme Steel & Malleable Iron Works, Buffalo.

Avitus J. Heysel, Branch Mgr., E. J. Woodison Co., Buffalo 7.

Frank T. McQuillan, Plant Mgr., Standard Buffalo Foundry, Inc., Buffalo 7.

Terms Expire 1949

John C. Nagy, Chief Chem., Chas C. Kawin Co., Buffalo 14.

Leo C. Smith, Pres., Lakeside Bronze, Inc., Buffalo 7.

John R. Wark, Salesman, Queen City Sand & Supply Co., Buffalo 7.

Terms Expire 1950

Edw. J. Roesch Supt., American Brake Shoe Co., Buffalo 12.

Leonard Greenfield, Plant Mgr., Samuel Greenfield Co., Buffalo.

Carl A. Harmon, Chief Met., Hanna Furnace Corp., Buffalo 2.

Wisconsin Chapter

(Established 1935)

President—R. J. Anderson, Works Mgr., Belle City Malleable Iron Co., Racine.

Vice-President—Robert C. Woodward, Chief Met., Bucyrus-Erie Co., So. Milwaukee.

Treasurer—Richard F. Jordan, Sales Mgr., Sterling Wheelbarrow Co., West Allis.

Secretary—Arthur C. Haack, Vice-Pres., Wisconsin Grey Iron Foundry Co., Milwaukee.

Directors—Terms Expire 1948

Geo. Tisdale, Zenish Foundry Co., West Allis 14.

P. C. Fuerst, Asst. to Supt., Falk Corp., Milwaukee.

D. C. Zuege, Tech. Dir., Sivyer Steel Casting Co., Milwaukee.

Terms Expire 1949

C. M. Lewis, Secy-Treas., Badger Malleable & Mfg. Co., So. Milwaukee.

Arthur K. Higgins, Met., Allis-Chalmers Mfg. Co., Milwaukee.

Terms Expire 1950

Walter W. Edens, Met., Badger Brass & Aluminum Foundry Co., Milwaukee.

Albert F. Pfeiffer, Patt. & Fdry. Div., Allis-Chalmers Mfg. Co., Milwaukee.

Joseph G. Risney, Pres., Risney Foundry Equipment Co., Milwaukee.

Green Sand Properties Committee Studies Sand Test Reproducibility

REPRODUCIBILITY OF sand test results is being studied by the Green Sand Properties Committee, according to Bradley Booth of Carpenter Bros., Milwaukee, chairman of the committee. Earlier work of the committee has shown the need for checking laboratory equipment and testing technique.

The committee has accepted the offer of H. W. Dietert, president, Harry W. Dietert Co., Detroit, to visit the participating laboratories. Mr. Dietert will note variations in equipment installations, check scales with a standard set of weights, pay especial attention to humidity and temperature during testing, and check the uniformity of operation of testing equipment.

★ CHAPTER ACTIVITIES ★

news

Chicago

MEMBERS AND guests of the Chicago chapter of the A.F.A. to the total of 1200 attended the chapter's annual stag outing and golf tournament at Lincolnshire Country Club, south of Chicago, on Saturday, August 9. Favored by an ideal, warm and sunshiny day close to 500 played golf, the remainder split their time between horseshoes and other arranged activities.

A popular feature, and continued from last year, was the boxing and wrestling matches. A select card was run off including five boxing bouts, three rounds each, and two wrestling "acts," 15 minutes to a fall. At seven dinner was served in the big tent, specially put up each year for this occasion.

Immediately after dinner, a fine array of prizes were presented to the lucky winners in golf and horseshoe pitching, and to those fortunate enough to hold lucky numbers. A floor show and entertainment, featuring six high-class specialty acts topped off the evening and brought the outing to a close.

Chapter officers and the outing committee deserve credit for the manner in which the day's program was handled, for managing a crowd of such proportions is a complicated matter.

Northeastern Ohio

R. H. Herrmann
Penton Publishing Co.
Chapter Reporter

RESUMING a series suspended during the war years, Northeastern Ohio chapter held its annual sum-

At the microphone Geo. A. Howard, general supervisor of apprentice training, Canadian National Railways, tells Eastern Canada foundrymen a few things about apprentice training. Seated is Chapter Chairman Henry Louette, Warden King Ltd., Montreal.

May meeting of the Northeastern Ohio chapter was devoted to the Old Timers from in and around the Cleveland area.
(Photos courtesy Sterling N. Farmer, Sand Products Corp., Cleveland)

mer outing July 11 at the Pine Ridge Country Club, near Cleveland. Some 175 members and guests were on hand.

The golfers completed an afternoon round, undeterred by a brief rain, and horseshoe pitching and swimming also preceded the big athletic event of the day—the softball contest between the foundrymen and the vendors. Victors for the first time in the chapter's history, the vendors carried off the perpetual trophy, a miniature cupola. The score was a convincing 22-11.

Chapter Treasurer F. Ray Fleig and Ray Crosby, both of Smith Facing & Supply Co., Cleveland, were manager and captain, respectively, of the winners; while the founders were led by George Leroux of National Malleable & Steel Castings Co., Cleveland, who was also scorekeeper.

An enjoyable dinner in the clubhouse, followed by the distribution of prizes rounded out the day. Arrangements were handled by H. J. Trenkamp, Ohio Foundry Co., retiring Chapter President; L. P. Robinson, Werner G. Smith Co., and Chapter Director L. F. Miller, Osborn Mfg. Co., all of Cleveland.

Monthly meetings of the chapter will be resumed in October.

Central Ohio

D. E. Krause
Battelle Memorial Institute
Chapter Reporter

THE CUSTOMARY full program of games, fellowship and fun, featured the annual outing of Central Ohio

(Continued on Page 79)

Apprentice group present at the May 9 meeting of Eastern Canada & Newfoundland chapter meeting held at the Mount Royal Hotel, Montreal, Que. Prizes were distributed to winners of the chapter's apprentice contest.

CHAPTER MEETINGS
SEPTEMBER-OCTOBER

SEPTEMBER 15

QUAD CITY
Fort Armstrong Hotel,
Rock Island, Ill.
W. B. McFerrin
Electro Metallurgical Co.
Cupola Operation

SEPTEMBER 19

TEXAS
Rice Hotel, Houston

ONTARIO
Royal Connaught Hotel, Hamilton
J. E. Rehder
Bureau of Mines, Ontario
Bureau of Mines Service to Foundry Industry

TRI-STATE
Mayo Hotel, Tulsa
R. G. McElwee
Vanadium Corp.
Gray Iron Metallurgy and Foundry Practice

SEPTEMBER 20

BIRMINGHAM DISTRICT
Roebuck Country Club
Annual Outing

CENTRAL INDIANA
Lake Shore Country Club, Indianapolis
Annual Outing

SEPTEMBER 22

NORTHWESTERN PENNSYLVANIA
Moose Club, Erie
N. J. Dunbeck
Eastern Clay Products, Inc.

SEPTEMBER 23

TIMBERLINE
Oxford Hotel, Denver
John Burgess
Simonds Saw & Steel Co.
Grinding Wheels and The Foundry

SEPTEMBER 26

CHESAPEAKE
Lynchburg Hotel, Lynchburg, Va.
Thomas W. Curry
Lynchburg Foundry Co.
Chemically Treated Sand

SEPTEMBER 30

CENTRAL MICHIGAN
Post Products Club House, Battle Creek
R. G. McElwee
Vanadium Corp.
Specifications

OCTOBER 2

SAGINAW VALLEY
Fisher Hotel, Frankenmuth, Mich.
John P. Sellas
Michigan Steel Casting Co.
Precision Casting of High Strength Materials

OCTOBER 3

WESTERN NEW YORK
Hotel Touraine, Buffalo
Henry C. Winte
Worthington Pump & Machinery Corp.
Gates and Risers

OCTOBER 6

METROPOLITAN
Essex House, Newark, N.J.
Clyde A. Sanders
American Colloid Co.
Casting Defects and Foundry Sand Practice

CHICAGO
Chicago Bar Association
Round Table Discussions

CENTRAL ILLINOIS
Jefferson Hotel, Peoria, Ill.
C. O. Burgess
Union Carbide & Carbon Co.
Structure and Properties of Cast Iron

OCTOBER 7

BRITISH COLUMBIA
Hotel Vancouver, Vancouver
National Officers Night

MICHIANA
St. Joseph, Mich.
M. E. Brooks
Dow Chemical Co.
Magnesium Foundry Practice

OCTOBER 10

EASTERN CANADA-NEWFOUNDLAND
Mount Royal Hotel, Montreal
R. L. Lee
General Motors Corp.
Man to Man on the Molder's Bench

CENTRAL NEW YORK
Onondaga Hotel, Syracuse
L. P. Robinson
The Werner G. Smith Co.
Variables in the Core Room

CANTON DISTRICT
Yant's Cottage, Canton, Ohio
W. B. Wallis
Pittsburgh Lectromelt Furnace Corp.
National Officers Night

TWIN CITY
Covered Wagon, Minneapolis
O. J. Myers
Werner G. Smith Co.
Core Materials and Core Making Procedures

PHILADELPHIA
Engineers Club, Philadelphia
B. P. Mulcahy
Cupola Operation

OCTOBER 14

ROCHESTER
Seneca Hotel
W. A. Hambley
Falls Mfg. Co.
Casting Defects in the Gray Iron Foundry

NORTHERN ILLINOIS & SOUTHERN WISCONSIN
Freeport, Ill.
Palmer E. Hanson
Rockwell Mfg. Co.
Molding Machines and Molding Methods

OCTOBER 17

TEXAS
San Antonio

The head-chef of the Central Illinois chapter's clambake does not look as if he worried about keeping the chapter members and guests supplied with food. Although he seems to be enjoying his work it certainly was a warm job, judging from the steam that is erupting from that huge pile of clams.

Proof of the food is in the eating and from the clam shells stacked here they must have been good.

Two more gourmets amidst a sea of shells delve into a clam for one of Mother Nature's tastiest morsels.






A more than enthusiastic crowd put in its appearance at the annual outing of the Northeastern Ohio chapter held July 11, Pine Ridge Country Club, near Cleveland. An afternoon devoted to both baseball and golf featured the first part of the program followed by a dinner and floor show. With such a program a good time was the rule and not the exception. The photos on this page were contributed by Sterling N. Farmer, Sand Products Corp., Cleveland, who was official outing photographer.

chapter August 9 at the Columbus Riding Club, Columbus.

Golf, horseshoes, darts and other sports events were on the afternoon program; dinner and entertainment on the evening's.

J. G. Lummis, A. P. Green Fire Brick Co., Columbus, and his committee arranged for the entertainment, and reservations were handled by Chapter Director W. L. Deutsch, Columbus Malleable Iron Co.

Southern California

TENTH ANNUAL Summer Outing and Stag of Southern California chapter was held August 9 at the Lakewood Country Club, Long Beach.

Baseball, golf, horseshoes, races and other athletic contests and events, highlighted the event earlier in the day. Dinner was served in the afternoon, and was followed by the entertainment.

J. J. Derkin, Warman Steel Foundry, Vernon, headed the entertainment committee. Chapter Treasurer E. D. Shomaker, Kay-Brunner Steel Products, Inc., Alhambra, took care of ticket reservations, and J. J. Hyatt, Grant & Co., Los Angeles, handled golfing arrangements.

EDUCATIONAL SCHOLARSHIPS

(Continued from Page 50)

the University, on a foundry subject approved by his advisor.

The student will find the Foundation most cooperative in providing material, specimens and whatever else might be done to assist him in the development of a worthwhile paper or practical problem, under the guidance of his advisor.

5—*The student will consult with his advisor and the Foundation in regard to a position within the industry upon graduation.*

It is the Foundation's desire to see that a student is located in a plant where his particular personality and ability will be most compatible with the character and personnel of the plant.

In addition to the above, prospective students will be interested in the following general policies as they apply to the Foundry Educational Foundation plan:

1—*The Foundation is authorized to collect contributions from firms in the U.S.A. only. Thus citizens only shall be eligible for the scholarships.*

Arrangements may be made to create similar programs, using contributions by other countries, to support their own students. All of the funds of the Foundation are from firms within the U.S.A. The Articles of Incorporation which legalize the Foundation in the State of Ohio, restrict contributions to this country only.

2—*Scholarships are to be awarded without regard to race, creed or color.*

K. H. Donaldson

Awards of scholarships are on the basis of merit alone and on the applicant's potential ability to succeed in the industry.

One man in each of the universities is responsible for the development of this program within his particular college. At Case Institute of Technology this individual is Prof. K. H. Donaldson, Head of the Department of Metallurgy; at University of Cincinnati it is Prof. R. S. Tour, Head of the Department of Chemical and Metallurgical Engineering; at Cornell University it is Prof. Peter E. Kyle, Professor of Metallurgy; at Massachusetts Institute of Technology it is Prof. Howard Taylor, Associate Professor of Mechanical Metallurgy; at Wisconsin it is Prof. George J. Barker, Chairman of the Dept. of Mining and Metallurgy.

The Foundation has opened an office at Room 1009, Public Square Building, Cleveland 13, Ohio, under the guidance of George K. Dreher, Executive Director.

H. F. Taylor

R. S. Tour

G. J. Barker

P. E. Kyle

★ SEPTEMBER WHO'S WHO ★

C. W. Briggs

C. W. Briggs, recipient of the Wm. H. McFadden Medal of the American Foundrymen's Association, was graduated from Stanford University, Calif., in 1926 and was awarded the degree of engineer in 1928 . . . He served as a miner, underground for Phelps Dodge Mining Co., Bisbee, Ariz., and later was made laboratory assistant in metallurgy at Stanford University . . . His entry into the research field was with the Standard Oil Co., Richmond, Calif., in 1928 . . . The following year he was placed in charge of metallurgical research for Pacatome Ltd., San Francisco, a position from which he resigned to enter the U. S. Naval Research Laboratory, Anacostia, Washington, D.C., in 1930 . . . He was advanced to assistant physicist and in 1935 was appointed physical metallurgist in charge of the steel castings section, foundry and research consultant to the Navy department on steel castings and gamma ray radiography . . . Is now affiliated with Steel Founders Society of America as technical and research director . . . His findings have been published widely by the trade press and he is a frequent speaker at meetings of technical societies . . . Member of AIME, ASM, American Society of Naval Engineers and A.F.A.

E. A. Blake

The treatise on molding machines which appears herein was prepared by E. A. Blake who spent 10 years as a patternmaker in Cleveland pattern shops . . . He possesses a technical school education . . . The author became affiliated with The Osborn Mfg. Co., in March, 1929 . . . Representing the Osborn firm as a foundry technician he made two trips to Russia during the early thirties . . . He was primarily concerned with foundry installations and worked on a consulting basis. . . Mr. Blake has also been a member of the company's service and development engineering departments . . . For about the past ten years he has been sales representative and engineer in the Michigan territory with Detroit as headquarters.

C. K. Donoho

The sixteen year association of C. K. Donoho with American Cast Iron Pipe Co., Birmingham, Ala., has been one of steady advancement . . . His course has run along these lines: chemist (1931-33); cupola foreman (1934-35), sales engineer (1935-36), melting superintendent (1936-38); plant metallurgist (1939-46) and chief metallurgist . . . Widely known in his field, the author's writings have been published by a large number of foundry and metallurgical publications . . . He has appeared before chapter and annual meetings of ASTM, A.F.A., Electro Chemical Society and many other technical groups . . . Nature of subjects includes cupola melting, centrifugal casting, foundry metallurgy and related subjects . . . Hometown: Gallatin, Tenn. . . A Vanderbilt University (Nashville, Tenn.) graduate he received his Bachelor of Arts in 1930 and Master of Science the following year . . . Member of A. F. A., AIME, American Welding Society, Electrochemical Society, ASM, SAE and Steel Founders Society.

F. C. Cech

The author was born in Vienna, Austria . . . Obtained his education in American schools and colleges . . . Began his patternmaking career in Cleveland with American Steel & Wire Co., Cuyahoga Works . . . Was placed in a similar position with Wellman, Seaver & Morgan Engineering Co., and Corrigan McKinney Steel Co., both of Cleveland . . . Became pattern checker and assistant foreman while affiliated with Cleveland Automatic Machine Co., Cleveland . . . Was appointed pattern shop foreman for Allyne-Ryan Foundry Co., Cleveland . . . At present is technical patternmaker, Cleveland Trade School, Cleveland . . . Has been active in the A.F.A. Patternmaking Division for many years and was 1945-46 division chairman . . . Has written numerous articles for the trade press and for vocational magazines . . . Is well known for his A.F.A. convention papers on patternmaking and allied subjects . . . Member of A.F.A.

G. E. Staahl

A member of the American Association of Spectrographers and a frequent contributor to the technical press, G. A. Staahl is one of the authors contributing to this issue . . . Born in Corning, N.Y., he attended and graduated from Northwestern University's (Evanston, Ill.) undergraduate and graduate school in 1940 and 1942, respectively . . . As a laboratory assistant, Corning Glass Works, he was associated with the firm from 1932-35 . . . He was appointed instructor, Northwestern University (1940-42) . . . With the Army Signal Corps for one year he served as an instructor . . . Joining H. Kramer & Co., Chicago, in 1943, he was made research physicist . . . Methods and techniques of spectrographic analysis used in brass and bronze foundries is covered in the paper of which he is co-author with Mr. Halliwell.

D. E. Krause

Metallurgical developments with which D. E. Krause has been associated are described in seven U. S. patents issued in his name . . . At present he is a member of the supervising staff of the division of foundry technology at Battelle Memorial Institute, Columbus, Ohio . . . Holds two degrees from the University of Wisconsin.

Madison, a Bachelor of Science and Master of Science . . . Prior to joining the staff at Battelle, Mr. Krause was a chemist and metallurgist for the Brillion Iron Works, Brillion, Wis. . . . A frequent contributor to metallurgical literature and has spoken before many technical societies . . . In addition to the A.F.A., Mr. Krause is a member of AIME, and ASM.

G. P. Halliwell

The newly-elected vice-chairman of the A.F.A. Brass and Bronze Division, G. P. Halliwell, is a native of Providence, R.I. . . . In his brass and bronze activities Mr. Halliwell has served on the research committee and as vice-chairman of the program and papers group . . . He is also a member of the association's committee on fluidity testing . . . Attended and received his Bachelor of Science degree in chemistry from Worcester Polytechnic Institute, Worcester, Mass., (1915) and his Master of Science in metallurgy from Yale University, New Haven, Conn. (1920) . . . Began his industrial career with Bridgeport Brass Co., Bridgeport, Conn., as chemist in 1916 . . . Left in 1920 to accept a position as metallurgist, Westinghouse Electric Corp., East Pittsburgh, Pa. . . . Joined the faculty of Carnegie Institute of Technology, Pittsburgh, as assistant professor of metallurgy and taught there until 1935 . . . Began his association with H. Kramer & Co., Chicago, the following year . . . Has spoken before meetings of scientific groups on such subjects as cold working and recrystallization of copper, and the effect of impurities on rolling of copper . . . Part author (with G. E. Staahl) of paper found in this issue on spectrographic analysis.

H. R. Dahlberg

A metallurgical graduate from the University of Minnesota, Minneapolis, Mr. Dahlberg is associate professor, school of engineering, Oregon State College, Corvallis . . . Began his association with the castings industry in 1942 as radiographer, Minneapolis Electric Steel Castings Co. . . . Also served as a molder, R. R. Howell Co., Minneapolis, and as a teaching assistant, University of Minnesota . . . During World War II saw duty as engineering officer aboard a destroyer escort and was discharged in 1946 . . . Mr. Dahlberg won first prize in the A.F.A. National Essay Contest sponsored in 1943 . . . Holds membership in A.F.A., AIME and American Society for Metals.

A.F.A. CHAPTER DIRECTORY

◆ 38

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Secretary—D. E. Krause, Battelle Memorial Institute, 505 King Ave., Columbus, Ohio

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Secretary-Treasurer—L. H. Denton, Baltimore Convention Bureau, 1714 O'Sullivan Building, Baltimore 2, Md.

CHICAGO CHAPTER
Secretary—Victor Rowell, Velsicol Corp., Chicago, Ill.

CINCINNATI DISTRICT CHAPTER
Secretary—Earl F. Kindinger, Williams & Co., Inc. 1921 Dunlap, Cincinnati 14, Ohio.

DETROIT CHAPTER
Secretary—R. E. Cleland, Eastern Clay Products, Inc., 1128 United Artists Building, Detroit 26.

EASTERN CANADA AND NEWFOUNDLAND CHAPTER
Secretary—John G. Hunt, Met. Dept., Dominion Engineering Works, Ltd., P.O. Box 220, Montreal, Que., Canada

METROPOLITAN CHAPTER
Secretary—J. F. Bauer, Hickman, Williams & Co., 70 Pine St., New York 5.

MEXICO CITY CHAPTER
Secretary—N. S. Covacevich, Casa Covacevich Foundry Supplies & Equipment, Mexico City, D. F., Mexico.

MICHIANA CHAPTER
Secretary-Treasurer—V. S. Spears, American Wheelabrator & Equipment Co., Mishawaka, Ind.

NORTHEASTERN OHIO CHAPTER
Secretary—Robert D. Walker, Werner G. Smith Co., 2191 W. 110th St., Cleveland, Ohio

NORTHERN CALIFORNIA CHAPTER
Secretary—J. Fred Aicher, 116 New Montgomery St., 339 Rialto Building, San Francisco 5.

NORTHERN ILLINOIS-SOUTHERN WISCONSIN CHAPTER
Secretary—Lester C. Fill, George D. Roper Corp., Rockford, Ill.

NORTHWESTERN PENNSYLVANIA CHAPTER
Secretary—Harry L. Gebhardt, United Oil Mfg. Co., 232 W. 21st St., Erie, Pa.

ONTARIO CHAPTER
Secretary-Treasurer—G. L. White, Westman Publications, Ltd., 137 Wellington St., Toronto, Ont., Canada

OREGON CHAPTER
Secretary-Treasurer—A. B. Holmes, Crawford & Doherty Foundry, 4604 S.E. 17th Ave., Portland 14, Oregon

PHILADELPHIA CHAPTER
Secretary-Treasurer—W. B. Coleman, W. B. Coleman & Co. 9th & Rising Sun Ave., Philadelphia 40.

QUAD CITY CHAPTER
Secretary-Treasurer—C. R. Marthens, Marthens Co., 2323-4th Ave., Moline, Ill.

ROCHESTER CHAPTER
Secretary-Treasurer—Leon C. Kimpal, Rochester Gas & Electric Corp., 89 East Ave., Rochester 4, N. Y.

SAGINAW VALLEY CHAPTER
Secretary-Treasurer—L. L. Clark, Buick Motor Div., General Motors Corp., Flint 4, Mich.

ST. LOUIS DISTRICT CHAPTER
Secretary—Paul E. Retzlaff, Busch-Sulzer Diesel Engineering Co., 5819 Lindenwood, St. Louis, Mo.

SOUTHERN CALIFORNIA CHAPTER
Secretary—John Wilson, Climax Molybdenum Corp., 650 So. Grand Ave., Los Angeles 14, Calif.

TEXAS CHAPTER
Secretary—H. L. Wren, 629 M & M Building, Houston 2, Texas

TIMBERLINE CHAPTER
Secretary—C. E. Stull, Manufacturers Foundry Corp., 3434 Brighton Blvd., Denver, Colo.

TOLEDO CHAPTER
Secretary-Treasurer—Rudy Van Hellen, Unitcast Corp., Box 8, Station "E" Toledo 9, Ohio

TRI-STATE CHAPTER
Secretary—Clyde B. Fisher, Enardo Foundry & Mfg. Co., Tulsa, Okla.

TWIN CITY CHAPTER
Secretary-Treasurer—Alexis Caswell, Manufacturers' Association of Minneapolis, Inc., 100 Metropolitan Building, Minneapolis 2.

UNIVERSITY OF MINNESOTA STUDENT CHAPTER

WASHINGTON CHAPTER
Secretary-Treasurer—A. D. Cummings, Western Foundry Sand Co., Seattle.

WESTERN MICHIGAN CHAPTER
Secretary—Donald A. Paull, Sealed Power Corp., Sanford & Keating Sts., Muskegon, Mich.

WESTERN NEW YORK CHAPTER
Secretary—Fred L. Weaver, Weaver Materiel Service, 1807 Elmwood Ave., Buffalo 7, N.Y.

WISCONSIN CHAPTER
Secretary—Arthur C. Haack, Wisconsin Grey Iron Co., 2561 N. Cambridge Ave., Milwaukee, Wis.

RESEARCH

(*Continued from Page 36*)

either by means of high frequency inductive heating or oxyacetylene flame heating.

It is expected that this research will disclose the optimum microstructure which is essential for the successful selective hardening of pearlitic malleable iron to achieve the necessary depth and hardness in the hardened zone and do so with sufficient speed of heating so as to make the progress commercially applicable.

Information should be obtained which will provide complete data relative to method and speed of heating, maximum depth of hardening, hardness, gradient media, and method of quenching.

The centrifugal casting committee, aluminum and magnesium division, completed during the past year a series of tests on the feasibility of centrifugal casting aluminum and magnesium alloys, followed by a very complete study of the resulting castings including x-ray examination for solidity.

The same committee now proposes to undertake the next step in this project, which involves the design of experimental castings to enlarge the knowledge of operational requirements, relative density, grain size, mechanical properties, production yield, freedom from segregation and other related items.

The Canadian Bureau of Mines, Ottawa, Ont., Canada will carry on the work of the latter committee.

Government Issues Book On Commodity Specs

A *Supplement to National Director of Commodity Specifications* has recently been published by the U.S. Department of Commerce, Washington, D.C. This book contains a classified and alphabetical list and brief descriptions of specifications of national recognition.

This edition has been published for the purpose of determining what specifications exist and how they apply. It is felt that the usefulness of the many commodity specifications in existence is greatly increased if there is a means for locating and comparing them.

PERSONALITIES

(*Continued from Page 63*)

sylvania and Chicago, and was associated with the Harbison-Walker organization for more than 30 years.

T. E. Barlow, recently a research engineer for Battelle Memorial Institute, Columbus, Ohio, has joined Eastern Clay Products, Inc., Jackson, Ohio, as general sales manager. Widely known in foundry circles as a technical speaker and writer, Mr. Barlow has been active in the industry since 1935, in which year he became associated with Ecorse Foundry as chief metallurgist. He was later foundry engineer for Vanadium Corp. of America. Mr. Barlow has been active in many national technical groups of A.F.A., and has served as Chairman of Central Ohio chapter.

C. E. Nelson, Jr.

T. E. Barlow

C. E. Nelson, Jr., has been appointed to the newly-created post of assistant to the president, Waukesha (Wis.) Motor Co. The new duties will be in addition to those of director of purchases and production planning, which he assumed in 1936. He is a graduate in business administration from the University of Wisconsin, Madison.

W. F. Bates, formerly associated with Rheem Mfg. Co., was recently named New England regional sales manager for Phosphor Bronze Smelting Co., Philadelphia. **H. C. Geittmann, Jr.,** who has been sales engineer for the Standard Steel Works Div., Baldwin Locomotive Works, and foundry engineer for Steel Sales Corp., was appointed casting division sales manager of the Phosphor Bronze organization.

A recent visitor to the National Office was **Vittorio Dettin,** Engineer of Odero-Terni-Orlando, Genoa, Italy, one of the largest shipbuilding and machinery foundry organizations in that country. Mr. Dettin is on a tour of American foundry plants in connection with the rehabilitation of the Italian foundry industry.

Another recent visitor to the National Office was **Rene Baumes,** Foundry Manager at the French Automobile Works of establishment Berliet and Co., Lyons, France. Mr. Baumes is here studying various processes in making of steel castings, also core blowing methods and mechanized cast iron production.

Cleveland Norcross, executive secretary of the Office of Scientific Research and Development, resigned that position July 1

(*Continued on Page 86*)

COMMITTEES MEET

Educational *

Business Meeting

SEVEN CHAPTERS sent representatives to this meeting.

In reporting the activities of the Engineering Schools Committees, the chairman of the committee said that the group would continue with their present work and attempt to complete it as soon as possible; that the Engineering Schools Committees would cooperate with the Foundry Educational Foundation and that the committee hoped to increase the activities of chapter educational committees in connection with engineering schools.

A new approach to foreman training, that of teaching and selling foreman training to top management through talks, periodicals, and a well organized program of foreman training is being prepared and recommended by the sub-committee.

Work on the revision of apprentice training standards is proceeding and the new standards will cover molders and coremakers as well as patternmakers.

The remainder of the session was devoted to activities of the chapter educational committees and the various representatives present contributed much to the discussion.

* Officers elected for this division are reported in the June issue p. 48.

Sand

Mold Surface

A STUDY is being carried out whereby each committee member obtains two specimens of metal penetrated sand. Each member is to determine, in any way they see fit, the chemical and physical properties of the penetrating metal, the sand penetrated and the properties of the metal and sand prior to penetration.

Annual Lecture

THE MEETING opened with a discussion concerning the selection of the subject for the 1949 Charles Edgar Hoyt Annual Lecture. Past lectures were reviewed and the subject of steel castings was decided upon. Requests for suggestions as to who might be invited as the 1949 lecturer brought forth a number of names prominent in the various activities of the steel castings industry.

A series of lectures to be sponsored by the committee at the 1948 Annual Convention will be on the subject "Test Procedures for Quality Control of Castings." Lectures will cover the following fields: cast iron, malleable iron, light alloys, brass and bronze and steel.

Speakers for these lectures have been contacted and in some cases have already accepted the invitation to speak.

Steel*

Business Meeting

FOLLOWING THE election of officers for the division a committee report on non-destructive testing was read.

Possible research projects for the Steel Division were touched upon rather informally but final decision rests with the division's Research Committee, which has several projects under consideration.

* Officers elected for this division are reported in the June issue p. 48.

PERSONALITIES

(*Continued from Page 84*)

to join the American Institute of Physics, New York, as assistant director. A native of Denver, Colorado, Mr. Norcross is a graduate of the University of Pennsylvania, Philadelphia, and has spent many years in Washington, D.C. He joined the OSRD in 1940 as administrative officer.

A further visitor in Chicago was **Victor L. Cashmore** of the British Molding Machine Co., traveling in the United States to study methods of production, especially in highly mechanized foundry plants.

P. D. Humont, recently sand control supervisor for John Deere Tractor Co., Waterloo, Iowa, has joined Eastern Clay Products, Inc., Jackson, Ohio, as foundry service engineer. He will be principally concerned with the new plastic-coated sand. Graduate of Western Michigan College, Kalamazoo, he was associated with Harmon Foundry Co. at Waterloo before joining the Deere firm.


P. D. Humont


A. E. Cartwright

A. E. Cartwright has resigned as sales and technical representative for Canadian Foundry Supplies & Equipment, Ltd., Montreal, to accept the position of metallurgist with Crane, Ltd., of the same city. One of the most active members of Eastern Canada and Newfoundland chapter, A.F.A., Mr. Cartwright is Chairman.

K. E. Rose, recently assistant professor of mechanics and metallurgy at the University of Oklahoma, Norman, is now chairman of the department of mining and metallurgical engineering, University of Kansas, Lawrence.


D. C. Williams


K. E. Rose

D. C. Williams, recently A.F.A. Research Fellow at Cornell University, Ithaca, N.Y., has joined Ohio State University, Columbus, as assistant professor in the industrial engineering department. He will be concerned with instruction and research in

(*Concluded on Page 89*)

PERSONALITIES

(Continued from Page 86)

foundry technology. Mr. Williams is well known to the foundry industry through his work in the investigations of A.F.A. sand groups.

OBITUARIES

Frederick W. Willard, retired president of Nassau Smelting & Refining Co. (Tottenville, Staten Island), died August 11 at his home in Summit, N.J.

A nationally recognized metallurgist and chemical engineer, he was associated with Western Electric Co. for more than 40 years, prior to his retirement in April of last year. Mr. Willard was born in Houghton, N.Y., and went to Ann Arbor to earn his college degree at the University of Michigan. He joined Western Electric Co. at Chicago as a research chemist in 1906.

He was elected vice president and a director of the Nassau Smelting organization when it was acquired by his firm in 1931, and president in 1937.

Alden C. Cummins, general superintendent of the Youngstown district of Carnegie-Illinois Steel Corp., died recently at his home in Youngstown.

A native of Pittsburgh, Pa., Mr. Cummins attended Lehigh University, Bethlehem, Pa., and joined the Duquesne steel works of the Carnegie organization in 1911, after an association with Western Electric Co. He was named assistant general manager of the Pittsburgh district in 1936, and retained that position until he moved to Youngstown.

George H. Paterson, production engineer for Sterling Engine Co., Buffalo, N.Y., died recently of a heart attack while on vacation at Wilkes-Barre, Pa.

James E. Woodard, treasurer of Anaconda Copper Mining Co. and its affiliates, died in New York after a long illness, July 23.

He was a native of Omaha, Neb., and a graduate of Creighton University, there. Mr. Woodard was for many years president of Metals Bank & Trust Co., Butte, Mont., and was a director of Montana Power Co. and Montana Flour Mills Co.

Peter B. Hunter, superintendent of the iron foundry, New York Air Brake Co., Watertown, N.Y., died recently at 59. Formerly assistant superintendent, he was named superintendent in January, 1945.

James W. McGill, plant superintendent of Kennedy Valve Mfg. Co., Elmira, N.Y., died recently at the age of 51 after a brief illness. He had been with the firm since 1916, and was named plant manager a year ago.

Harry N. Syster, mill sales supervisor for Latrobe (Pa.) Electric Steel Co., died July 21 at Latrobe. He was 55.

Associated with the firm for more than 30 years, he had been in his most recent position for the last ten. Previously, he was purchasing agent for several years.

1945 Geological Survey For Illinois Available

A 116-PAGE report of the *Illinois Mineral Industry in 1945* is now available from M. M. Leighton, chief, State Geological Survey, Urbana, Ill. A section of the pamphlet is devoted to clays and clay products; sand and gravel; fluorspar; coke and by-products, pig iron and magnesium compounds.

Prize For Oldest Magnesia Installation

A CONTEST TO discover the oldest installations of 85 percent magnesia insulation still functioning efficiently has been announced by The Magnesia Insulation Manufacturers Association. A total of sixteen prizes are being offered. The contest closes on October 10, 1947. Entry blanks may be obtained from the Association's offices at 1317 F Street, N.W., Washington 4, D.C.

Japs Prolong Life of Electrodes with Iron

THE JAPANESE ferroalloy industry effected appreciable savings in electrode life by wrapping thin sheet iron around the electrodes to minimize oxidation losses caused by hot gases and flame while melting, according to a report on Japanese ferroalloy metallurgy now available from the Office of Technical Services, Department of Commerce, Washington, D. C.

The 52-page report, prepared by the natural resources section of General Headquarters, Supreme Commander for the Allied Powers in the Pacific, is a detailed review of the Japanese ferroalloy industry, including metallurgical practices.

Excuse Us

In the July issue of AMERICAN FOUNDRYMAN, p. 25, it was erroneously reported that O. L. Voisard was chairman, Eastern Canada & Newfoundland chapter. Mr. Voisard is chapter vice-chairman and A. E. Cartwright, Crane Ltd., Montreal, is chapter chairman.